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BOOK-KEEPING AS A FINE ART.

Again we have the pleasure of presenting to our readers a searching analysis of the Detroit municipal lighting report. It is a valuable lesson in applied statistics. We have not the least prejudice against municipal lighting, because it is municipal, but we object most strenuously to claims made in behalf of municipal lighting which cannot be substantiated. In the present instance the faults in the report are the same old faults to which we have before called attention. They are common faults in central station bookkeeping, public and private, but cannot for this reason be used legitimately in a comparison of public and private plants. Our exposure of the facts in this case may seem merciless, but it is better for the public that they should come out without reserve, for many a municipality has been tempted by the example of Detroit. We have investigated many reported successes in municipal lighting and have found as a rule the same kind of statistical dodging and shuffling that characterizes the report in hand. Now the art of electric lighting is an established success, and it needs no apologies. Nothing permanent is to be gained in it by concealing the facts as to its real cost, by whomsoever produced.

The first serious flaw in the Detroit report is the entirely inadequate treatment of depreciation. We have many times gone upon record on this topic and propose to make use of every fresh opportunity. Depreciation is generally entirely neglected in reports on the cost of lighting from both public and private plants, and we suppose some credit should be given for even partial recognition of its existence. The amount charged this year is 3 per cent. on the total investment, which figure is built up from partial depreciations varying from 7 per cent. to nothing on various items. There are very varying opinions as to depreciation, but we do not see how annyone familiar with the art and both sane and honest, can assign to it so small a value, even if it could be treated as a sinking fund which it cannot. For a plant does not go to pieces through depreciation like the famous "one-hoss shay," "all together and nothing first," at the end of a fixed period, but requires replacements at uncertain intervals, thus breaking the continuity of any sinking fund scheme. As an annual depreciation, 3 per cent. is absurd. To be sure, we have known alleged experts to go upon the stand, and, having been duly sworn, to affirm the sufficiency of even smaller rates than this on electric lighting property. The utter failure of a 3 per cent. depreciation rate to maintain the value of the assets is in the main due to complete neglect of depreciation caused by changes in the art. The records of the central station industry in this country show beyond the shadow of a doubt that electric light plants have been turned upside down at intervals of ten years or less, merely by changes in the art, and quite irrespective of the physical depreciation of the several items replaced. It may be true that an arc dynamo of twenty years ago may be as fit for producing current as it ever was, but it has ceased to be desirable for the ordinary uses of a central station and only escapes the scrap heap through sentiment or lack of funds or credit for the purchase of modern apparatus.

Depreciation is very rarely properly taken into account even in plants under private ownership. It has usually been placed at a nominal figure to make a brave showing at the annual meeting.

When the inevitable day of reckoning has come, the result has been a reorganization of the company or a large increase of capital stock for "improvements" in municipal plants. Leaving depreciation to be taken care of by a future increase in investment is squarely dishonest whenever and wherever done. Moreover, it is foolish, for it has come to be evident even to a tyro in the wiles of high finance. In the Detroit scheme of salvation by bookkeeping a similar interesting process seems to have been applied to the operating expenses. It is an old and transparent scheme to charge up labor and material to construction instead of to maintenance and operation. It works well for a time, but murder will out, and in a term of years a fraud of this kind will become evident unless it, like depreciation, can be pushed over into the "improvemennt" account and lost in the shuffle. Another well-worn dodge comes to light in the "saving" of $1,200 annually by work previously paid for and now done by the city electrician. We have no doubt that this gentleman earns his salary, but if he does not find his present duties strenuous the office must have been a sinecure previously. This illustrates one of the greatest advantages of municipal ownership—the ability to play hunt-the-slipper with expenses between several departments. It reminds us of the double-shuffle in securities sometimes performed by banks under the same roof when the examiner calls, or still more of the interesting game that is played with three shells and a pea. It is instructive, too, to see the cost of energy computed from the switchboard readings. Does the municipality reckon the losses in distribution as an asset? Taken as a whole this report is thoroughly typical of municipal business methods—it is the same cheerful old humbug with which we have regaled our readers in former years. It is no worse, perhaps, than some reports of corporations—to damn it with faint praise—but it can hardly be termed scrupulous.

The Measurement of High Temperatures.

A paper by Lummer and Pringsbeim, abstracted in the Digest this week, is of particular importance in view of the extent to which high temperature operations have been recently developed. All the older methods of measuring high temperatures have proved rather unsatisfactory, even at the moderate limit of 1,000 C., as a glance at a list of melting points will show. The results even for well-known substances like gold and silver, are by no means precise, and when one enters the field of modern research with the electric furnace, even the thermoelectric couple is of small avail and pyrometers of the usual kinds are a delusion and a snare. The bolometric method, on the contrary, seems to have shown great capabilities in this direction, and should come into extensive use. Of course, there may be in certain cases some doubt as to the complete absence of selective radiation, but the method has the very great advantage of offering the fourth power of the thing to be determined as the quantity to be measured, thereby lessening the experimental errors of the process. There is one disadvantage, however, in the bolometric method, which is that the formulæ may lead to trouble in case of a change of state, as when a substance boils and wraps itself in a vaporous envelope; but nevertheless it gives a most promising line of attack on high-temperature problems in general, and the experimental difficulties will doubtless be greatly reduced by experience. Few people have an adequate idea of the difficulties of thermometry even at ordinary temperatures, and the relief offered by the newer plan of apparatus will be felt in more than one branch of industry.

Safe Electric Railroading.

The recent horrible accident at Newark again directs attention to the grave dangers which have come with the development of electric traction. The heavy and fast-running cars now in common use cannot be treated in the matter of safety precautions like the old-fashioned horse car. As we had occasion to point out recently, in connection with a couple of Institute papers on braking, the modern electric car has a long, dangerous space ahead of it even when on a clean and level track, and when the car is on a grade and the track is slippery, this space is very greatly increased. Under these conditions a grade crossing becomes intrinsically dangerous and doubly so when it is approached on a down grade. We are not disposed to go so far as to say that crossing a steam road at grade should never be permitted in electric railroading, but it should certainly be forbidden unless there is at least a hundred yards of clear and level track on the side of approach, and the car should come to a full stop at least a hundred feet from the crossing and then proceed slowly and under full control. Most collisions on electric lines have come from underestimating the distance required for stopping the cars, and in the present state of our knowledge there is no excuse for this error. Electric roads should heed the lessons that have been learned by the steam railroads and not go blundering along imperilling the lives of their passengers. When the schedule is quickened or a new type of heavy car is introduced, the capabilities of the brakes should be fully tested on good track and bad before entering upon the new conditions in service.

More than this, we think that power brakes should be required on all lines having grade crossings or operated with a maximum speed of more than, say, ten miles per hour. Power brakes for electric cars are now thoroughly reliable and are vastly more effective than hand brakes. When public safety is at stake the extra expense should be thrown out of consideration. When the power brake question has come up there have too often been representatives of the railways to arise and throw discredit on power brakes and to raise all sorts of hypothetical objections in order to avert the expense of a change. The whole question of power brakes *vs.* hand brakes was threshed over years ago on the steam roads, and then as now the corporations often tried to shirk the responsibility. The question of stoves in railway cars was similarly treated, and the deliberate misstatements made about the difficulties of steam heating ought to have secured numerous indictments for perjury. The penitentiary is a good place for those who imperil the public to save expense. The present tendency is to abolish grade crossings entirely, and it is a sound principle to follow, although it may bear heavily upon certain roads. By rigorous regulation of equipment and operation, the majority of grade crossings can be made secure, and common sense rather than an inflexible rule is the best guide in determining whether grade crossings should be permitted. The question of safety should be taken up on its merits in each particular case, and there will generally be little difficulty in reaching a reasonable result. But at whatever cost and inconvenience, disasters like the Newark horror should be made impossible, and those responsible for them should be held mercilessly to account.

The Construction of Sensitive Galvanometers.

An interesting paper on this subject was read by Mr. C. G. Abbott before the American Association for the Advancement of Science in Washington. When the sensitiveness of a galvanometer is being discussed on paper, the figures are frequently deceptive. In order to arrive at the greatest possible sensitiveness, the instability of magnetic control may be so great that the zero of the instrument is constantly shifting. This represents a greatly increased uncertainty in the use of the galvanometer as an instrument of precision. The ordinary method by which the sensitiveness of a galvanometer is determined is to find the deflection corresponding to a known current of fairly considerable strength, and thence compute the small

current strength which would give one millimetre deflection of the light-spot at a range of one metre. As to whether this small deflection could actually be used with precision, for current measurement in the then existing magnetic condition of the apparatus, is not adverted to. Moreover, the millimetre deflection at a metre may be an unduly large deflection that could be greatly magnified by extending the range to several metres. Some instruments will permit of this range being extended, while with other instruments, no benefit may thereby result. Consequently, the only precise way of defining the sensitiveness of a galvanometer is to obtain the most sensitive magnetic and optical condition by trial, and then to determine the actual small strength of current which can be detected with certainty. It does not much matter just what the angular magnitude of this minimum current may be, so long as its presence or absence can be detected. The value of this minimum current is usually the true measure of the sensitiveness of the instrument.

In the instrument described by Mr. Abbott there are eight sets of magnets and 16 coils. The period of oscillation being about ten seconds, the minimum detectable current is about 10^{-12} ampere or the millionth of a micro-ampere. The resistance of the whole apparatus is, however, only 1.6 ohm. If, therefore, the coils were wound with very fine wire, so as to produce a high-resistance galvanometer of about 20,000 ohms resistance, the number of turns in the coils would be increased about 100 times, and the minimum detectable current with the otherwise unchanged instrument would be about one-hundredth less. In the above sense the order of ideas in connection with the terms "current-detector" and "galvanometer" is reversed. It is customary to regard a "current-detector" or galvanoscope, as a relatively crude device as compared with the more sensitive instrument for measuring the current called the "galvanometer." But in many departments of research the question asked is whether, under certain conditions, a measurable electric current does or does not flow, and what is the limiting feeblest current that can be observed. Such a current-detector is thus the highest and most sensitive type of galvanometer.

COMPOSITE TRANSMISSION.

Mr. McAllister's article on page 351 of this issue relates to an electrical system which contains various novel and interesting features. The principle of superposing alternating and continuous currents on one and the same circuit has already been used in telephony, and also in simultaneous telephony and telegraphy. It has likewise been proposed by M. Leblanc to superpose direct and alternating currents in a power transmission circuit, but not in the particular arrangement of circuits here represented. The latter contemplates split transformers, one of the methods by which direct and alternating currents are simultaneously used in telephony. This is another illustration of the constantly-increasing bond of union between the methods of electric power-transmission and electric signaling or electric telephony. The more closely these various originally distinct systems are united, and regarded alike, the more benefit each is likely to derive from the development of the other.

The fundamental principle of the system described by Mr. McAllister is the remarkable well-known fact that if two equal co-phase alternating current strengths of the same frequency are simultaneously impressed upon a conductor, the power wasted in heating the conductor is not twice but four times as great as when either current flows alone. But if the two equal alternating-current strengths differ in frequency, then the power wasted in heat is only double that due to either alone. A continuous current comes within the scope of this proposition as a particular case, namely, as a current of frequency zero. The physical peculiarity of the method described lies in its special adaptability to the two-phase system. Two-phase machinery is commonly connected with a two-to-three-phase transformer before reaching the transmission line, in order to make the saving of copper available that belongs to the three-phase system over and above the two-phase or single-phase system. But in the case now under consideration we should expect to reverse this order, and use a three-to-two-phase transformer between three-phase machinery and the line, in order to employ the two-phase line transmission which this composite method prefers.

The article claims that the composite system will transmit 12½ per cent. more power for the same loss of power in conductors; so that 11 per cent. of copper can be saved over the three-phase system for the same pressure load and loss of power. This, however, does not adequately represent the merit of the system. It would often hardly be worth while changing from three-wire to four-wire transmission merely for the sake of 11 per cent. of saving of conductor. The point is that in order to keep the regulation of the distribution system within the limits required for good incandescent lighting, when the motor load on the same main is subject to rapid fluctuation, it is necessary to have a much smaller total drop of pressure, and more copper in the system than would be necessary if the motors were replaced by lamps. In the composite system the motor drop and the lamp drop are divorced, and consequently the copper can be much reduced. Fifteen per cent. drop to the lamps may now be tolerated without unsteadiness, whereas five per cent. might be necessary when every elevator motor sings its song of grief at starting to every incandescent lamp within a mile. There can be no doubt that there are advantages in keeping the motor load and the lamp loads on separate circuits, and the system here discussed does this virtually, although not literally.

A more purely theoretical point of interest in the article is the method by which the voltages may be quantitatively determined in the case of multi-frequency circuits. In the ordinary single-frequency circuits, the effects of phase difference upon the magnitudes of voltages and currents is made simple by the use of plane vectors, and the computation of polyphase circuits finds natural expression in complex quantities. If we take a certain standard phase, and the phase in quadrature with this be denoted by the symbol j, then all or any phases whatsoever may be made to fall within the expression $a \pm jb$. But when we come to a bi-frequency circuit, j is not enough. We are obliged to use three-dimensional space, and to reckon in terms of the unit mutually-perpendicular vectors, i, j and k. Thus a pair of adjoining wires in the composite transmission system of Fig. 1 in Mr. McAllister's article comprise between them a voltage of $\left(\frac{i}{2} + \frac{j}{2} + \frac{k}{\sqrt{2}}\right)$ the numerical value, or "tensor," of which is unity. Consequently, just as complex quantities are the natural and simplest language of the single-frequency circuit with difference of phase, so quaternions with their three-unit vectors seem to be the natural language of the bi-frequency circuit. It looks as though the tri-frequency circuit would drive us into four-dimensional space, so we beg inventors to content themselves with bi-frequency circuits for a while, until we can overtake them with adequate mathematical machinery, imagery, and stage setting.

Congresses for the St. Louis Exposition.

The board of directors of the St. Louis Exposition voted on February 10 to organize an International Congress of Arts and Science in connection with the Exposition, in accordance with the recommendations of the Administrative Board appointed in January to formulate a plan. The sum of $200,000 was set aside for the Department of Congresses. This sum will cover the expenses of the International Congress of Arts and Science and the publication of the proceedings thereof, and all other expenses connected with the promotion of other congresses and conventions. The administrative board of the International Congress of Arts and Science now consists of President Butler, of Columbia University; President Harper, of Chicago University; President Pritchett, of the Massachusetts Institute of Technology, Boston; President Jesse, of the University of Missouri; Mr. F. J. V. Skiff, director of the Field Columbian Museum, Chicago; Mr. Herbert Putnam, Librarian of Congress, Washington; Mr. Frederick W. Holls, New York, member of the Hague Tribunal. The appointment of Professor Simon Newcomb, of Washington, the eminent astronomer, as president of the International Congress of Arts and Science, was confirmed, as was that of Professor Hugo Muensterberg, of Harvard University, and that of Professor Albion W. Small, of the University of Chicago, as vice-presidents of the congress. The president and vice-presidents were created a scientific committee to make detailed arrangments for the congress, subject to the general control of the Administrative Board and the director of congresses. The plan recommended by the Administrative Board was adopted by the directors of the Exposition, viz.:

There will be one general Congress of Arts and Science, to begin September 19, 1904. The congress will have one definite task, namely, to bring out the unity of knowledge and thus to bring harmony and inter-relation into the scattered scientific work of the day. Leading scholars from the whole world will be invited to discuss every theoretical and practical science in its definite position, to trace the development of each science during the last century, and to state the open problems of to-day. An honorarium and a sum for traveling expenses will be allowed to all who submit a paper in response to an invitation and who contribute a definite piece of work to the uniform plan. The plan also provides for the active participation of men of affairs. For example, the group on commerce, or on finance, or on labor, will attract business men. Groups on colonial policy, or arbitration, or municipal government, will attract politicians. The plan further provides for the participation of independent assocations, national or international congresses of specialists, and scientific or popular meetings.

The provision for the publication of the proceedings of the International Congress of Arts and Science which is made in the appropriation above mentioned, will form a lasting contribution to the scientific literature of the country, and be a permanent memorial to the work of the St. Louis Exposition.

The action of the board of directors inaugurates the first attempt ever made at an international exposition to hold a series of related congresses, all of which should tend towards the development of one central idea. The congresses hitherto held in connection with expositions have been entirely independent, and forced to rely upon the convenience and pleasure of persons interested for their attendance. It is the first time, also, that a definite sum of money has been set aside to obtain the presence of men distinguished in the various fields of art, literature and science. The American Institute of Electrical Engineers is already taking steps to arrange if possible for an electrical congress that shall fit into the general scheme.

The New Telegraph Competition.

Details have already been given in these pages of the new competition that has sprung up in the telegraph field, with St. Louis as its center. It is now stated that active work will be begun within a week upon the new telegraph line which will connect Milwaukee and Chicago with St. Louis and Kansas City. Contracts have been let and the construction will be started just as soon as the necessary material can be secured. The work will start from the Chicago end and extend south and west as rapidly as circumstances will permit. The capital necessary to carry out the project has been secured. Right of way has also been secured over the greater part of the contemplated route, which will take in the principal cities and towns between Chicago and St. Louis and St. Louis and Kansas City. The new company will be capitalized for $2,000,000 and about $1,250,000 bonds will be issued. No name as yet has been selected, but it will be either the Midland Telegraph Company or the Continental Telegraph Company.

At a meeting held in the offices of the National Telegraph News Company, Chicago, between St. Louis capitalists and officers of the Chicago & Milwaukee Telegraph Company, the National Telegraph News Company and the Sempire Clock Company, final arrangements were perfected whereby the new telegraph line becomes a reality. Mr. Orthwein, vice-president Germania Trust Company, St. Louis; R. H. Orthwein, capitalist, St. Louis; B. E. Ryan, representing the Sempire Clock Company, St. Louis; W. R. Stewart, president National Telegraph News Company, Chicago; L. M. Martin, formerly general manager Iowa Central Railroad Company, and F. E. Crawford, secretary and treasurer Chicago & Milwaukee Telegraph Company, are among those interested.

The Chicago & Milwaukee Telegraph Company operates a ten-wire line between Chicago and Milwaukee and, it is claimed, controls about 90 per cent. of the commercial messages between these points. The line has been in operation for more than twenty years. It is capitalized for $100,000 and has a bonded indebtedness of $50,000. The National Telegraph News Company is an Illinois corporation and controls the majority of the page printing tickers operated in Chicago in the interest of the commercial and financial boards.

The Sempire Clock Company, of St. Louis, manufactures electric clocks and electric appliances. It has about 1,000 electric synchronized clocks in Chicago and a greater number in St. Louis. It is the intention of the new company to enter into active competition with the other telegraph companies for commercial messages, leased wires, etc., at the beginning, but later it expects to enlarge the scope of its operations and do a general telegraph business between the points reached by its wires. It will also endeavor to bring into Chicago by means of the Chicago-St. Louis line all of the independent telephone companies now operated in the territory covered by this line.

Apparently telephone competition has sprung up also, as a special dispatch from Chicago of February 20 says: Contracts have been let for the partial construction of a new telegraph and telephone company's line to operate between Chicago and other Western cities, to be called the Continental Telegraph Company. The contract calls for the laying of ten copper wires under the superstructure of the South Side Elevated Railways from the business district to the end of the road. From that point the line will run on poles to the largest cities in Illinois, including Bloomington, Peoria, Springfield, Decatur and East St. Louis. It will enter St. Louis through a conduit. This distance is 410 miles, and the building cost is estimated at $400,000. A line will also be built to Kansas City, and one to complete the circuit through to Sioux City, and to St. Paul, Minneapolis and Duluth. The Kansas City line will cost $600,000.

Wisconsin Independent Telephone Interests.

The Wisconsin Independent Telephone Association held its annual convention in Milwaukee on February 11 and 12, President Richard Valentine, of Janesville, being in the chair. Members were present representing between 40 and 50 indpendent companies doing business in the State. There was a large number of exhibits of telephone apparatus. According to a statement made at the meeting the number of independent telephones in use in the State is five times more than those controlled by the Bell or Wisconsin Telephone Company.

Papers were read as follows: "Competition," by M. L. Berger, of La Crosse; "The Necessity of Uniformity," by A. L. Hutchinson, of Weyauwega; "Generation and Generators," by C. W. Farr, of Chicago; "Prospective Telephone Legislation," by J. C. Harper, of Madison; "Comparative Merits of the Central Energy and the Magneto Systems," by W. A. Taylor, of Madison, and "New and Old Telephone Problems," by J. E. Keelyn, of Chicago. A general discussion followed the reading of these papers.

The Largest Power Plant in New Hampshire.

STEAM engines and water wheels of 24,125 hp aggregate capacity are employed to operate the mills of the Amoskeag Manufacturing Company, at Manchester, New Hampshire. This great plant occupies a space on both sides of the Merrimack River extending about 5,000 feet down stream from the dam and about 2,000 feet wide including the river, which has a width of approximately 400 feet for the greater part of the distance. In this space are located about one dozen large mills for spinning and weaving cotton cloth, also a larger number of smaller auxiliary buildings such as a machine shop, dye house, foundry, cloth and cotton storehouses. During the year ending June 30, 1900, these mills operated more than 300,000 spindles, employed upwards of 7,000 persons, and produced 116,990,523 yards, or 29,877,626 pounds of cotton cloth, and 1,809,663 bags. To drive the machinery for these operations, spread over nearly one-half square mile of territory, involves no mean problem in power distribution. Before the advent of the electric drive, steam and water were the agents relied on exclusively to accomplish the work of power distribution, and they performed their task effectively though at some disadvantage. The dam previously mentioned at the up-stream end of the site occupied by the Amoskeag Mills, gives a fall of somewhat more than forty feet for the entire flow of the Merrimack River. Two canals at different levels are fed with water from a basin which draws its supply from the river behind the dam. The lower of these canals may receive water either through wheels connected with the upper canal or directly from the basin. These canals extend on lines approximately parallel with the river to points below the mills of the Amoskeag Company. Between the two canals and between the lower one and the river a part of the Amoskeag Mills is located and is driven by water wheels. The remaining mills, on the opposite side of the Merrimack, derive their power entirely from steam.

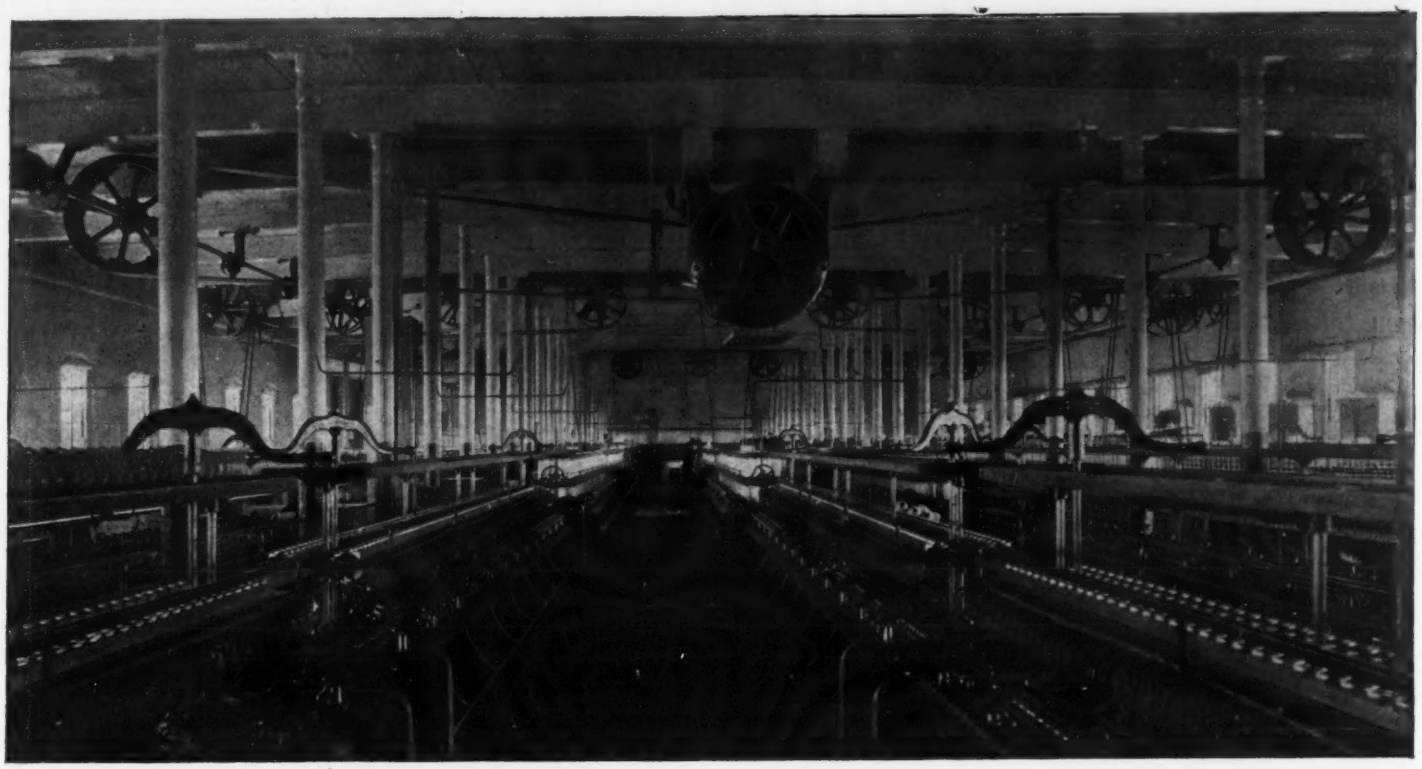


FIG. 1.—GENERAL VIEW OF AN INTERIOR IN AMOSKEAG MILLS.

In the way just named, 23 water wheels or pairs of wheels are employed with an aggregate capacity of 9,500 hp. The majority of these wheels are vertical, but five are horizontal. Some wheels are geared to main lines of mill shafting, and other wheels are direct-connected to main shafts. Steam power is utilized to drive some of the mills at all times of year, and other mills only at times of low water. Prior to the introduction of the present equipment of electric motors for driving some of the mills, the number of steam engines employed at different points in the plant was seventeen. At present the number of these engines has been reduced to ten, with an aggregate rating of 14,625 hp. A part of these engines are direct connected to main shafting, while others have a belt connection. Some engines are connected to the same shafting with water wheels, some operate only when the supply of water is low, and some are in use every working day of the year. In individual capacity, the seventeen engines formerly employed ranged from 20 to 2,000 hp. The ten engines now in use are rated between 75 hp for the smallest and 4,500 hp for the largest. The seven engines that have been displaced, which had capacities of 20 to 60 hp each, were all of the simple type and non-condensing. Of the ten engines now in use, one of 75 hp, one of 150 and one pair of 1,800 hp are simple non-condensing. The simple engines that operate condensing include one of 250 hp, one of 2,000 hp, and one pair of 1,000 hp. Compound engines operating condensing include one of 1,200 hp, one of 1,500 hp, and one of 4,500 hp capacity. There is one triple-expansion condensing engine rated at 2,150 hp. Gravity condensers are used with all engines that operate condensing. Steam for these ten engines is generated in three boiler plants composed of Manning upright tubular boilers. One plant of ten boilers rated at 150 hp each, located up-stream from the larger group of mills, supplies steam for the 2,150-hp and the 150-hp engines nearby. Further down stream and on the opposite side of the river, is a battery of 12 boilers rated at 150 hp each and devoted to the operation of the 4,500-hp engine in an adjoining building. Close to this last-named building is the main boiler plant, which generates steam for the remaining engines and for other purposes about the mills. This main plant contains 57 boilers at 150 hp each. The other engines are numbered as follows:

Number.	H.P.	Number.	H.P.
1	1,000	5	1,800
2	2,000	6	1,500
3	250	8	4,500
4	1,200		

The 2,150-hp engine with its boiler plant is located about 1,500 feet up stream from No. 9 mill, which is partly driven by power from this engine. As the main boiler plant is on one side of the Merrimack River and a great part of the engines it supplies are on the other side, an extended system of steam pipe is necessary. A main element in this system is a loop of 20-in. pipe carrying steam at high pressure. This loop is about 2,700 ft. long and crosses the river in two places. An exhaust pipe of 15 in. diameter also crosses the river.

Under the conditions thus far outlined it was decided to replace a part of the steam distribution of power, and to provide for some extensions by the introduction of electric motors. The first step in this direction was to install a 500-kw, 600-volt, 3-phase, 60-cycle

generator on the shaft of the 2,150-hp engine, which shaft also carries three horizontal water wheels of 1,537 hp total capacity. Power from this generator is used to operate four induction motors of 550 hp combined capacity in No. 9 mill, some 1,500 ft. down stream. The generator has been in operation several years, and quite recently a much larger one has been added to extend the electric drive. This latest generator is rated at 2,500 kw, 600 volts, 60 cycles, 3 phase and 120 r.p.m., is of the internal revolving magnet type, and this magnet is mounted directly on the shaft of a cross-compound, vertical engine. The external frame of this generator is 18 ft. 4 in. in diameter and the shaft on which the revolving magnets are mounted has a diameter of 2.5 ft. The engine cylinders measure 33 x 66 x 48 in., steam enters the high-pressure cylinder at 160 pounds pressure and the rated capacity is 4,500 hp. There is little doubt that this connected generator and engine form respectively the largest electric and steam unit in the State of New Hampshire. Besides driving the electric generator with which it is directly connected, the 4,500-hp engine has a belt connection with a shaft that drives four arc light dynamos. Each of these arc dynamos is arranged for four circuits of 2,500 volts and 6.6 amp each, giving the dynamo a capacity of 125 enclosed arc lamps. The main purpose to which this 2,500-kw generator is to be devoted is the operation of 3-phase, 60-cycle motors. Incidentally some arc lamps are supplied through constant-current transformers. One group of three such transformers, each rated at 4,000 volts and 7.5 amp, has already been installed. At present the load of motors is not complete, but 19 motors of 150 hp each, three

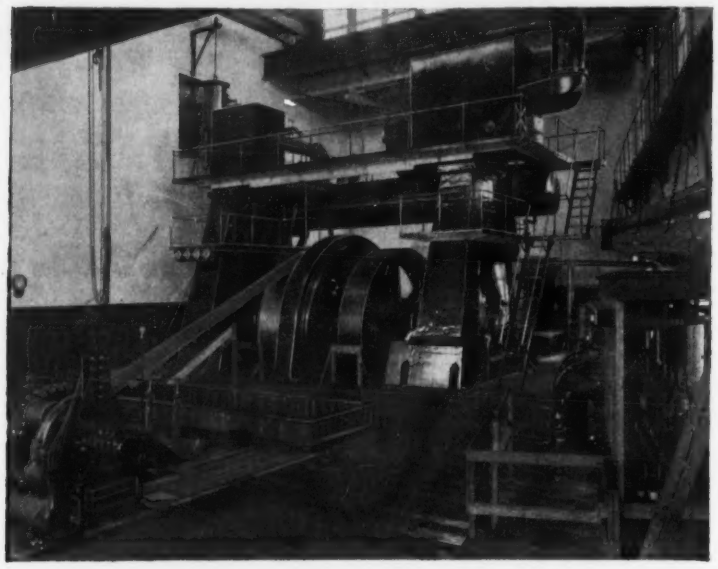


FIG. 2.—AN ENGINE ROOM, AMOSKEAG MILLS.

motors of 100 hp each, and one motor of 500 hp are either in position or are being added. This gives a total thus far of 3,650 hp capacity, in motors, but as 550 hp capacity is supplied by the 500-kw generator, only 3,100 hp in motors is connected to the 2,500-kw generator. All of the 150-hp and the 100-hp motors are of the induction type, and rated to operate at 585 r.p.m. under full load, and at 600 r.p.m. under no load. These 150-hp and 100-hp motors are all belted to line shafting in the mills, the usual arrangement being to hang a motor from the ceiling and belt it to shafting beneath the looms of the floor above. All belts are thus avoided between looms and ceiling.

The above generators and motors were built by the General Electric Company, and the 4,500-hp engine by McIntosh & Seymour. The 500-hp motor above mentioned is of the three-phase, synchronous type and will be direct connected to the driven shaft. A part of the foregoing motors have been installed in new mills, where they constitute the only source of power. Other motors, however, have been erected in mills where an equipment of water wheels and steam engines already existed. In such mills the engines have had to carry the load of the water wheels, or at least a part of it, at times of low water. Now, the electric motors will be utilized to make up any deficiency in the amount of work done by the water wheels. The tendency thus is to shift loads from some engines distant from the boiler plant to the 4,500-hp unit, which is close to it.

The introduction of electric drive for spinning and weaving operations has rendered the measurement of the power consumed in these lines of work an easy matter. In one test made with a 150-hp induction motor at the Amoskeag Mills, 462 box looms at work on staple ginghams were driven and the rate of consumption of electrical energy by the motor was 140.67 hp, so that the average rate per loom was .319 hp. In another similar test, a 150-hp induction motor drove 557 box looms, also working on staple ginghams, and drew 180.50 electrical hp from the line. In this case the average consumption per loom was .324 hp. It should be noted that each of these tests gives the power consumed by the motor, so that all motor and shafting losses are included in the figures given per loom. The second test shows how a motor may be overloaded with no material falling off in efficiency. A test of 44 spinning frames and 13 spoolers, driven by a motor rated at 150 hp, showed a consumption by the motor of 156.52 hp. It was found by an independent test that the 13 spoolers, containing 1,300 spools, required 6 hp, so that 150.52 hp was consumed to operate the spinning frames. These frames contained 9,312 spindles and the number of spindles operated per horse power was, therefore, 62.

After passing to its switchboard, the 600-volt, 3-phase current from the 2,500-kw generator is distributed to the motors by four circuits of three cables each. Each of these cables has a cross-section of 1,000,000 cm and a weight with insulation of 3.5 pounds per foot. Three circuits, each 1,000 ft. in length, extend from the switchboard in the generator room to motors across the river, passing through an enclosed footway over the river and then through a tunnel to the mills. One circuit 800 ft. long feeds motors on that side of the river where the 2,500-kw generator is located.

Besides the electrical equipment already noted, the mills of the Amoskeag Company contain the following smaller dynamos used for lighting purposes. Three arc dynamos with capacity of 75 enclosed arc lamps each, there being four 1,520-volt, 6.6-amp circuits to each dynamo. Five arc dynamos with capacity of 50 open arcs each, or 2,500 volts and 10 amp. Two arc dynamos with capacity of 60 open arcs each, or 3,000 volts and 9.6 amp. Two arc dynamos rated at 30 open arcs each, or 1,500 volts and 9.6 amp. Two 125-volt dynamos for incandescent lighting, one with capacity of 150 amp and the other for 250 amp. Including the four 125-lamp arc dynamos and the three 50-lamp, constant-current transformers, previously mentioned, the total capacity at these mills for the operation of enclosed arcs amounts to 875 lamps. In open arcs the capacity amounts to 430 lamps, making the total rating of arc lamp equipments 1,305 arcs. There are in use throughout the mills 1,387 open and enclosed arcs, also 577 incandescent lamps. As may be seen from these figures, most of the lighting is done with arc lamps, and one of the weave rooms in Nos. 4 and 5 mill presents a typical example of their arrangement. This room is 467 ft. 8 in. long, 95 ft. 4 in. wide, and contains 840 looms. Lighting is done by 58 arc lamps arranged in two rows of 15 lamps each, and two rows of 14 lamps each, along the room in the direction of its greater dimension. The rows of lamps are 24 ft. apart, and the lamps in each row are 32 ft. apart. Each arc lamp thus supplies light for about 14 looms.

An interesting test of the power required to drive an engine and shafting connected by belts to the loose pulleys for about 3,000 looms, also a dress room, was recently made. The total length of shafting in this test was 11,353 ft., ranging in diameter from 5 in. down to 2⅛ in. To drive the engine, shafting, belts and loose pulleys, required 378 hp, the looms not being in operation.

These interesting facts concerning the largest power plant in New Hampshire have been collected through the courtesy and with the aid of the engineers of the Amoskeag Manufacturing Company.

Paris-Brussels Electric Road.

A Paris dispatch says: Some French and Belgian engineers are working on a scheme to reduce the time of the journey by rail between Paris and Brussels, 191 miles, from six to two hours by electric trains, so that Parisians may lunch at home, take a train to Brussels, transact business there and return to Paris for dinner. The cost each way is to be $4. The system will be double track, with the accumulators of the cars united with each other by cables. All cars are to be first class. The termini will be in the center of business in each city. The trip will be made at the speed of ninety-four miles an hour, including stops.

Some Engineering Features of the Bedell System of Composite Transmission.

BY A. S. MCALLISTER.

IT is well recognized that, for the transmission of mechanical power, polyphase currents are required and a low frequency is desirable, while, for the lighting service, a high frequency is required and, as concerns the receiver, the equivalent of single-phase circuits must be used. When power is transmitted to both motors and lamps, there is made a compromise selection of polyphase currents, and a high frequency, that is, a frequency higher than is best suited to motor service. By a method, in the application of which complications are conspicuous by their absence, there may be obtained the simultaneous combination and separation within the same conductors of low-frequency polyphase currents for mechanical power and high-frequency single-phase currents for illumination. Upon the fact that superposed asynchronous currents and e.m.fs add as though in quadrature, depends the complete solution of the problem which confronts every engineer when determining the selection of equipments adapted to the requirements of both lamp and motor service.

Before discussing some of the practical applications of the simultaneous transmission of differing currents, it is well to establish the fact concerning the non-interference of asynchronous currents. If two currents, I and I_1, of different frequencies, pass simultaneously through a conductor, the effective line current will be $\sqrt{I^2 + I_1^2}$, and the line loss, for a resistance R, will be $I^2R + I_1^2R$, or the same as though each current acted alone. Any change in the value of either current has no effect upon the loss occasioned by the other. The importance of this result will be appreciated when it is remembered that, for direct or alternating currents of one frequency, the loss would be $I^2R + 2I\ I_1R + I_1^2R$, and hence there is not the same independence. This characteristic of asynchronous currents allows of the independent regulation of the e.m.f. impressed upon the receivers of the component systems supplied with power transmitted conjointly over the same conductors, for, with line losses independent, line drop must likewise be independent.

The Bedell system provides various methods for the joint transmission of direct and alternating currents, or of alternating currents of two frequencies, some of which will now be described in detail.

Fig. 1 represents circuits so interconnected as to obtain the advantages of joint transmission both in the high-tension primary mains and in the low-potential secondary distributing circuits. In the main power station are installed low-frequency polyphase generators of any convenient size, designed for any e.m.f. or number of phases, arranged to be operated in parallel according to the demands upon the polyphase system. The station contains also single-phase high frequency lighting generators, built for a high e.m.f. to feed directly to the line, or for a lower e.m.f. to be connected to the primary coils of step-up transformers. These latter generators may conveniently be so constructed as to maintain automatically the e.m.f. at the distant station at any constant value chosen for the lighting service. With a lagging current and especially with a current which changes its angle of lag with the ratio of the demands of the motors and the lights, the reactive drop would render perfect regulation by automatic compounding somewhat difficult to obtain. Since, however, the lighting load alone is to a large extent non-inductive, this result can easily be secured.

Current from the single-phase generator passes differentially through each half of each of the high-potential line transformer coils. The magnetizing effect of each half, therefore, neutralizes that of the other and the core is, consequently, unaffected by the flow of the single-phase current. The low-frequency power current does not interfere with the asynchronous current in the transmission line. Hence, the single-phase power is transmitted over the four conductors in all respects as though the polyphase generating and receiving apparatus were idle. At the receiving station the single-phase current is delivered at the two neutral points of the separate line transformers and passes into the lowering transformer where, being converted to the proper e.m.f., it supplies energy to the network of feeders for the lamp service. Thus the power for illuminating purposes in its travel from the generators to the receivers encounters only such circuits as are ordinarily provided for the transmission of single-phase current.

Consider now the polyphase equipment. The only change from standard high-tension transmission practice is in the use of two-phase rather than three-phase circuits; all apparatus intended to be operated by the low-frequency current being of standard accepted design and no change whatever being needed in its connection to the polyphase circuits. Motors of the synchronous or asynchronous type, or synchronous converters, are operated by methods too well known to need comment. A decided advantage is gained, however, over equipments now in use, due to the fact that the low frequency of the polyphase circuit is conducive to the satisfactory performance of all synchronous machinery and is accompanied with a low line inductance and improved regulation of the circuit e.m.f.; while the elimination of all unbalance of loads on the separate phases is a result, the desire to obtain which has led to the introduction into equipments now installed, of such complications in connections, switching devices, potential regulators, etc., that an adequate description thereof would require more space than that allotted to this article.

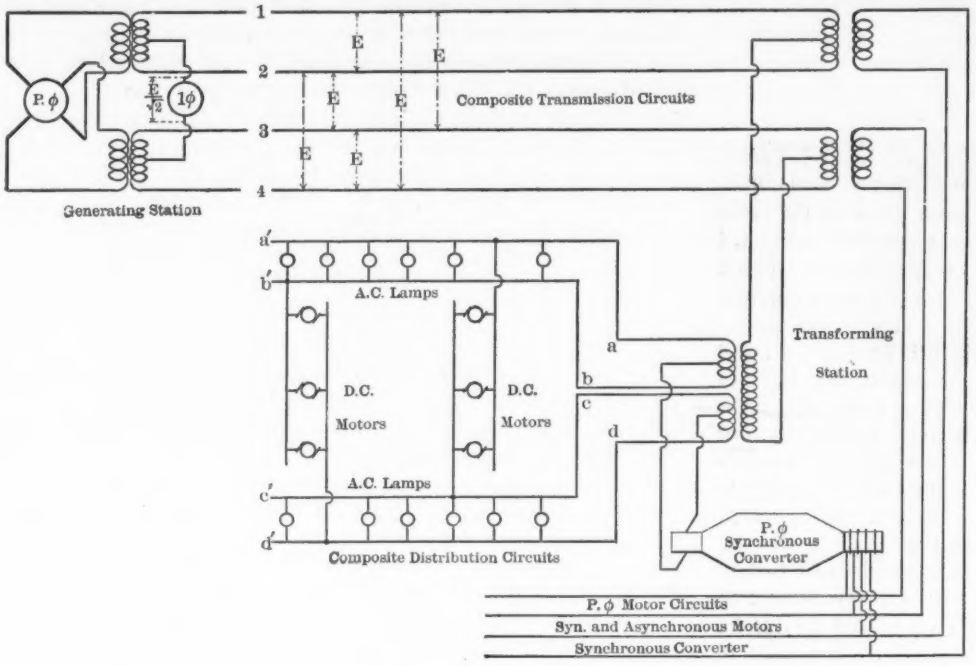


FIG. 1.—COMPOSITE TRANSMISSION AND DISTRIBUTION CIRCUITS.

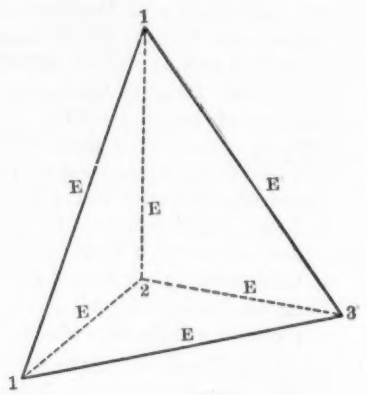


FIG. 2.—TETRAHEDRON OF E.M.FS.

Mention has been made of the substitution of the two-phase for the now universally employed three-phase system, and it is obviously true that, to transmit a certain amount of power over two-phase circuits, requires one-third more conducting material than when three-phase circuits are used, the e.m.f. and the line loss remaining the same, and it is also true that the loss due to any current in the two-phase system is not lessened by the flow of the superposed single-phase current. The question then arises as to any source of gain to be derived sufficient to offset the seeming additional cost

of line material. The fact is, that, without raising the effective line e.m.f., and at the former percentage of line loss, the composite system will transmit 150 per cent. as much power as the single-phase, or the two-phase system alone, or one and one-eighth times as much as the three-phase system, the amount of conducting material being the same in each case, so that the change from the popular three-phase system, in addition to securing the very desirable results of independence of regulation of the e.m.f. for lamps and motors and equality of division of loads on the polyphase system and permitting of the selection of frequencies adapted to the best operation of each type of machine, allows of an actual decrease in the cost of line conductors.

It will be recalled that the e.m.f. between opposite phase lines in

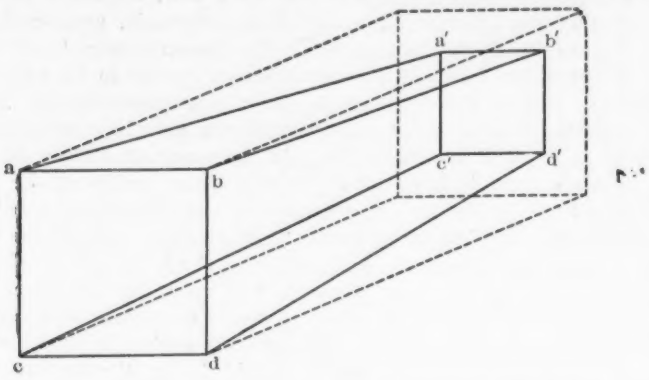


FIG. 3.—ALTERNATING-CURRENT AND DIRECT-CURRENT LINE DROPS.

a two-phase system, with interconnected neutral points, is only $\sqrt{\frac{1}{2}}\,E$, where E is the e.m.f. measured between wires of the same phase. When the neutral points of the two phases are separated by an interposed asynchronous e.m.f. of value $\sqrt{\frac{1}{2}}\,E$, the e.m.f. measured between opposite phase lines becomes E, since e.m.fs of different frequencies add as though in quadrature. By giving to the single-phase circuit (Fig. 1) this value of e.m.f., there is produced a novel condition of connections due to having four conductors, each of which is at the same measurable difference of potential from the other three. In attempting to represent this result graphically, one is confronted by the fact that in a single plane only three points can lie equally distant one from the other, and that a fourth point to be thus located must be out in space; in fact, the four points occupy the vertices of an equilateral tetrahedron (see Fig. 2).

The single-phase circuit has a line resistance, one-half of that of each circuit of the two-phase system. Hence, for the same percentage of line loss for the two systems, at an e.m.f. of $\sqrt{\frac{1}{2}}\,E$ for the former and E for the latter, the single-phase current must be $\sqrt{2}\,I$, where I is the current per phase of the low-frequency circuit, so that the lighting load may be $\frac{\sqrt{\frac{1}{2}}\,E\sqrt{2}\,I}{2\,I\,E} = \frac{1}{2}$ of the polyphase load. From this fact are obtained the values given above for the relative economies of the composite and other transmission systems.

An advantage possessed by the composite system over any other now in use is found in the fact that the motor loads may fluctuate through any range whatsoever and become so excessive in value as to cause the circuit-opening devices to remove all connections between the polyphase generators and the transmission lines, yet the lamps will be entirely unaffected. In consequence of the independence of the regulation of the component systems, each may be given a load much in excess of what would be considered admissible with circuits operated according to present-day practice. Thus, the line drop due to the almost non-inductive lighting load can conveniently be compensated for by accurate compounding at the generating station, while the load on the polyphase system is not limited in value to that amount which would interfere with the brilliancy of the lamps, and, moreover, due to the lower circuit frequency, a larger value of current may be transmitted in order to cause the former percentage of line drop allowed with the higher frequency.

The foregoing description has referred particularly to the differential system of primary transmission of asynchronous alternating currents, of which it is a good illustration. For low-tension secondary distribution, the common conductor system of superposed direct and alternating currents is admirably adapted. An application of this method is shown in Fig. 1, the direct current obtained from the direct-current side of a two-phase synchronous converter being introduced at the neutral points of the two distributing-circuit coils of the lowering transformer on the single-phase lighting system. A little consideration will show that thus connecting the converter terminals will tend to separate the potentials of similar sides of each transformer coil by an e.m.f. equal to that between the direct-current leads. When no direct current flows, this difference of potential will, obviously, be maintained between similar conductors throughout the alternating-current circuits. If a direct-current receiver be connected between these conductors the current which will flow will pass through one-half of one transformer coil in one direction and return in a reversed direction through an equal number of turns of another coil wound upon the same core. With regards to the core magnetism, therefore, no effect is produced by the direct current and, since within the conductors the dissimilar currents do not interfere one with the other, the e.m.fs impressed upon the alternating and upon the direct-current receivers are unaffected the one by the load on the other. Thus loads on the separate alternating-current circuits cause the e.m.fs of those circuits to be less at the distant end than at the transformer station, but only direct-current loads can decrease the difference of potential between similarly disposed alternating-current conductors.

An idea of the relative decrease of the individual e.m.fs at the distant end of the circuits when direct and alternating currents are flowing can be gained from a study of Fig. 3. Here $a\,b$ and $c\,d$ are the alternating e.m.fs at the station, while $a'\,b'$ and $c'\,d'$ are the corresponding receiver e.m.fs; $a\,c$ and $b\,d$ are the initial direct e.m.fs, while $a'\,c'$ and $b'\,d'$ are the final terminal e.m.fs. The drop in e.m.f. on each circuit is determined by the load on that circuit alone.

In the common conductor system of distribution, it is convenient to operate motors by direct and lamps by alternating current. The illumination will thus be unaffected by the fluctuations in the motor loads, while the lighting circuits may be given a low e.m.f. independent of the requirements of the motors.

It is worthy of note that no additional circuits whatever are needed for the common conductor system of distribution. Each lighting circuit is erected along a separate route, as is customary at present, and the circuits are interconnected only where there is a demand for power for the operation of motors. When a single consumer desires both motors and lights, as in office buildings, stores, etc., only three wires are taken to his premises.

For heavy factory work and where large amounts of mechanical power are used, the characteristics of the polyphase motor render its installation desirable, and there should be available for its operation polyphase current derived by transformation directly from the high-potential circuits. Such motor circuits are indicated in

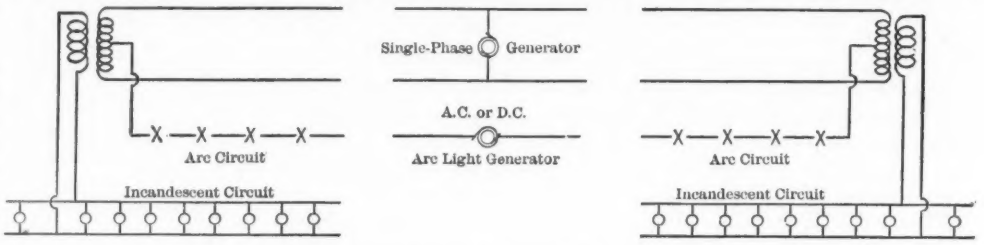


FIG. 4.—COMPOSITE LIGHTING CIRCUITS.

Fig. 1. The low-tension polyphase circuits needed for this purpose are well adapted to the requirements of synchronous converters for supplying power to direct-current traction motors.

It is interesting to observe that the differential system is applicable not only to the effective separation of the lamp and motor loads on long-distance transmission circuits; it may be applied equally as well to the simultaneous transmission of differing currents for the operation of arc and incandescent lamps from relatively local circuits. Fig. 4 represents a high-tension circuit for supplying single-phase current to lowering transformers for the incandescent lamp service. Without complications, this circuit is used as the return conductor for the arc light circuit, for which current is obtained

from a proper generator installed in the main station. Where a single series of arc lamps is desired, this method allows of a saving of fifty per cent. in the amount of conducting material for the arc light circuit.

It scarcely need be stated that the composite system is applicable to numerous interconnections of circuits, of which the above are but isolated examples, and that in each case the inherent characteristics of independence of regulation and economy of operation are preserved.

Radiant Efficiency of the Mercury Arc.

The February issue of the *Physical Review* contains a paper by Prof. William C. Geer giving the result of investigations on the radiant efficiency of the mercury arc. The opening paragraphs give references to the work of those who have experimented with the mercury arc, but neglects that of Jamin about 1882. The investigations by Hittorf, Righi, Skinner and others on the phenomena of electrodes in exhausted tubes are not touched upon. We give below a condensation of the paper:

In the year 1860 Way observed that an intense light was produced when an electric current was allowed to flow through a fine thread of mercury which was falling from an upper reservoir to a lower one. He had this "mercurial electric light" on the mast of a yacht off the Isle of Wight, where its brilliant radiation was observed from a distance of many miles. The newspapers of the day commented upon its intensity and suggested it as a means of artificial illumination.

The interest thus aroused in the discovery naturally stimulated investigation and as a result many patents have been issued, in this and other countries, whose main specifications describe a lamp for obtaining an arc between mercury terminals. Rapieff, in 1879, took out a British patent for an inverted U-tube having the ends dipping into mercury, and the arc playing either in air or in a vacuum. Rizet, in 1880, obtained a French patent. The design was similar to the above, while the U-tube is filled with nitrogen. Langhans, in 1887, obtained a German patent for a U-tube with legs filled with any metal or metalloid. By far the most interesting and thorough attempt to render this principle of commercial value has been made by Cooper Hewitt with what he calls a mercury "vapor lamp." He has patented a large number of designs.

None of these mercury vacuum tubes has proved to be practicable as a means of artificial lighting and consequently they have failed of commercial success. However, the mercury arc has rendered valuable service to pure science. The green lines, produced by this means are employed in spectrometric work as a source of monochromatic light of high intensity which can be maintained for a long time, when properly cared for, and which is comparatively easy to produce. The device commonly used in the production of the arc is some form of the tube, or "lamp," described by Arons in 1892 and in 1896. Many slightly different designs have been made by Lummer and others. These lamps all embody the same principles, viz., a U-tube of some sort having the two legs filled with mercury, through the ends of which platinum wires are sealed, the whole being exhausted as far as possible.

From the published results of the work of Arons and the fact that the arc gives out such a brilliant light, one would infer that the radiant efficiency, or the ratio of the luminous radiation to the total radiation, must be large. The paper then proceeds to describe the results of an attempt to measure the efficiency of that part of the radiation of the mercury arc which was transmitted through the glass tube within which it was formed. Any radiation from the glass itself was carefully corrected for and left out of account in the calculations.

The separate determinations varied considerably even at the same current. This variation may be due to several causes. In the first place the arc was extremely unsteady, the cathode being in constant motion. Arons states that the arc is a discontinuous one, basing his conclusion on the sound that is given by a telephone receiver when properly connected. Prof. Geer observed that when one places his ear close to the lamp an unsteady sound of low pitch can be distinctly heard. This unsteadiness is undoubtedly one of the causes for the variation in the efficiency determinations. Then, again, the mercury which distilled from the terminals condensed upon the cooler sides of the tube, forming an irregular layer, which absorbed considerable energy. Furthermore, the temperature of the tube at the time when the throw of the galvanometer was read varied a good deal with the different determinations, even in spite of great care. Since the total electrical energy used has been found to change with the temperature of the tube, it is quite probable that the efficiency may be influenced by this cause. Also the temperature of the tube would influence the rate of cooling and as a consequence it would be possible that the extrapolated values of the hot glass deflections may be in error in some cases. These errors could not be corrected with the apparatus at hand. The mean of a large number of determinations is doubtless quite near to the true efficiency.

Plotting efficiencies and currents as a curve, it would appear that, in general, the radiant efficiency of the mercury arc increases with the current. In other words, the intensity of the visible part of the spectrum increases more rapidly than that of the invisible part. This does not accord with the work of Ångström on the intensity of the radiation from vacuum tubes. To be sure, the case of the Arons lamp is not exactly similar to a vacuum tube. The condition here is that of a saturated vapor in contact with its liquid base, so that with the changing temperature the pressure in the tube changes as well. As the current is increased the temperature of the electrodes should increase and consequently the pressure in the tube should rise. According to the authority quoted the efficiency falls with an increase of the pressure. If the present measurements are correct the efficiency rises slightly under these conditions. In any event there is a field here which merits further and more thorough investigation.

The following are a few of the more common light sources and their comparative radiant efficiencies, which were measured by the general method described in the paper:

Source.	Comparative efficiency.
Illuminating gas, argand burner	1.61
Incandescent electric lamp	6.00
Arc light	10.04
Acetylene	10.50
Geissler tubes	32.00
Mercury arc	40.90 to 47.90

From these figures and the full data determined, it is seen that the mercury arc is quite remarkable. It has the highest known radiant efficiency. It is to be remembered, however, that these results indicate the efficiency only of that part of the radiation from the mercury arc which was transmitted through the glass tube within which the arc was formed.

When one recalls that the spectrum of mercury is a line spectrum it is to be inferred from the efficiency values that some well-defined lines or bands are to be found in the region of the infra-red. Indeed the high efficiency here recorded may in part be due to the presence of energy of such large wave length that the glass walls of the tube absorbed the waves, and, therefore, they were not taken account of in this method of determining the efficiency. The high heating of the walls of the tube may, at least to a slight extent, be ascribed to this cause. Several lines were predicted by Kayser and Runge, but they have not been found as yet, and, so far as could be found, nothing has been written which includes a systematic study of this portion of the mercury spectrum. In the near future it is purposed to publish the results of an investigation in this field.

Production of Zinc by Electricity.

United States Consul Bergh sends from Gothenburg the following translation of an article recently published by a local newspaper, in which he states that experts in metallurgy have for some time discussed the report that Dr. De Laval, after extensive experiments, has been able to produce zinc ore by electricity at the factory Önan, belonging to Trollhättans Elektriska Aktiebolag, Trollhättan. It is reported that the manufacture of carbide at Önan has been discontinued and the production of zinc by Dr. De Laval's method adopted. An expert states: "Dr. De Laval has for several years worked on the problem of producing zinc by electricity from lead-sulphur-zinc ores. He was probably led to this by his experiments in trying to separate iron from ores by electricity. An examining board has reported favorably on the method, and the result has been the organization of a company to exploit the invention and the ore deposits at Saxberget, near Ludvika. The minimum capital—$26,800—has already been paid, and the company will start operations as soon as circumstances will allow."

Analysis of the Seventh Annual Report of the Public Lighting Commission, Detroit, Mich.

THE annual report of the Detroit Public Lighting Commission is again at hand. In the ELECTRICAL WORLD AND ENGINEER, of February 15, 1902, we reviewed the Sixth Annual Report and it is with keen interest that we compare this report with the one that preceded it. The president's report states the cost of an arc lamp for the year ending June 30, 1902, to have been $63.82, a decrease under the preceding year of $3.49.

The items which make up the cost of an arc lamp are given as follows:

*Depreciation on the entire investment of $802,438.93, at an average of 3%, June 30th, 1902	$24,073.17
Interest on the net investment, July 1st, 1901, $721,861.56, for one year at 4%	28,874.46
Lost taxes (the amount the city would get as taxes were the plant owned by a private corporation) are figured by charging to the operation of the plant at the regular rate of taxation for the city, county and state. The probable assessed value based upon a comparison with the assessed values of other plants of like character, similarly located in the city, is placed at $389,183.00. This amount at $21.23 per $1,000 is	8,262.35
Cash cost of operation is	99,087.16
Making a total cost of	$160,297.14

Total cost proportioned between arc and incandescent plants according to output of each is as follows:

Arc plant	$136,140.73
Incandescent plant	24,156.41
Total	$160,297.14

Cost of operation per arc light (cost of operation divided by average number of lights, 2,133)	$63.82
Cost per arc light subdivided—	
Operating disbursements	$39.45
Interest at 4% on investment	11.49
Depreciation at 3% on investment	9.59
Lost taxes on investment	3.29
Total	$63.82

There are in this product $63.82, a number of factors; the variation of any of which would affect the total. We will examine these one at a time. The first is the divisor, 2,133, stated to be the average number of arc lamps operated during the fiscal year.

THE NUMBER OF LAMPS.

Regarding the number of lamps we quote the following from the ELECTRICAL WORLD AND ENGINEER of February 15, 1902:

"The reckoning of 2,035 lamps includes some 55 lamps operated in the beautiful Belle Isle Park. It is proper that lights on the paths and avenues of this island should be considered as a part of the street lighting system, but inasmuch as they are only operated until midnight, that is to say, half the time of the regular street lighting, it is improper that they should be reckoned at their full value in estimating this number. Half of them—say 27 out of 55—should be cut off from the figure 2,035 used as a divisor of the annual operating expense per one lamp operated. It appears also from an examination of the statement of arc lamps on page 31, that 26 lamps in buildings and not on the streets, are included in the calculation. This includes evidently seven lamps in the Public Lighting Commission's own building and yard, which cannot be considered as forming any part of the street lighting. The Public Lighting Commission in all its reports has included as a part of its output the current used in lighting its own stations and offices. This is clearly wrong. The lighting of these buildings is an operating expense. To include it as a part of the output in estimates of average cost per arc lamp is just as absurd as if a contractor should bill to a city the arc lamps he used in his own power house. A further deduction of seven, bringing the average number of arc lamps down to 2,001, is, therefore, necessary. The same item of lighting in buildings includes apparently about a dozen of 16 alternating arc lamps supplied from the incandescent system. These are used in lighting the Ferry Dock and other places at Belle Isle. They burn until 11:30 or midnight. If these lamps are to be counted as street lights, they should only be considered as half-time lights. But we are informed that the current of these lights is included in the incandescent lighting output of the plant, and the commission deducts from its total expense before figuring the cost per street light, an amount proportionate to the incandescent light output. If we are rightly informed about this, there should be a deduction of these 12 lamps also from the divisor of 2,033. This double credit to the plant is doubtless a mistake and will be corrected in future reports; but the assumption of credit for the lighting of the public lighting buildings is not accidental, and the reduction necessary on account of half-time lights on Belle Isle is indisputable."

These conditions still exist. The Belle Isle lights burn only until midnight and during the winter months fully half of them are switched off. The arc lamps in the public buildings other than the lighting station are alternating arcs, whose current is measured at the switchboard as incandescent lighting output. The lighting of the plant and the commission's offices is reckoned as output.

On page 29 of the report we have the following tabulation:

Lamps on Belle Isle	58
Lamps in buildings	22

Assuming the Belle Isle lamps to equal 29 lamps that burned full time, we have:

Lamps on Belle Isle	29
Lamps in buildings	22
Total	51

Deducting this number from the given average of 2,133 gives a true average of 2,082, which should be used as the divisor, and would make the cost of an arc lamp $65.32 per year. So far we do not question the figure for total cost, but merely the divisor used.

DEPRECIATION.

The next factor requiring examination is the Depreciation Charge. This is figured as it was last year and as it has been for several years at an average rate on the entire plant of 3 per cent. A note, however, is added this year which represents this 3 per cent. as "being the average on the different items of property as shown by the actual depreciation of different types, varying from 7 per cent. on incandescent plant, arcs and switches, 5 per cent. on steam plant, etc., to nothing on land." Depreciation accounts have always been the subject of much controversy, but there is hardly anyone who will deny that the Public Lighting Commission's treatment of the subject is inadequate. The history of the Public Lighting Commission may be summarized as follows: Work was started in 1894 by installing practically the earliest 100-light arc machines. Extensive experiments made to determine the feasibility of changing the open arc lamps to enclosed lamps, 1898-1899. Discarding direct-current arc apparatus for enclosed alternating arcs, 1901-1903.

It would be a very rash man who asserted that the present alternating enclosed arc lamp will **never** be excelled for street lighting. A much more rash man would hesitate to predict that we are near the limit in the economical production and utilization of steam. The student of these reports of the Detroit Municipal Plant is irresistibly forced to the conclusion that not only the bond issue, but a respectable proportion of what now ought to be running expense must be taken care of in the future.

It is to be noted here that the bond issue made on account of the plant is $650,000. A sinking fund to provide for the retirement of these bonds is maintained by the City of Detroit, but properly does not enter in any way into the accounts of the Public Lighting Commission. The cost of the plant in excess of $650,000 has been provided for by direct taxation; concerning which some remarks will be made later.

Each year ELECTRICAL WORLD AND ENGINEER has questioned the propriety of the average 3 per cent. allowance for depreciation made by the Public Lighting Commission. This year, notwithstanding the explanation in a foot note, the inadequacy of the allowance is even more apparent than it has ever been before. At this moment the commission is discarding its equipment of direct-current arc dynamos and lamps which has been used an average of 6 years. This apparatus will barely sell for its junk value. At the 3 per cent. depreciation rate there has been charged off from its cost 18 per cent. If we accept the 7 per cent. foot note rate, still only 42 per cent. has been charged off. Those familiar with the market for second-hand apparatus will agree that even a 12 per cent. depreciation would have been too little.

Again; during the year covered by the report the commission sold three 50-kw alternators for $2,670. These machines cost $7,500. The loss is $4,330. At 3 per cent. for their 5 years' service $1,125 has been charged off; or at 7 per cent., $2,625; leaving the difference to be accounted for in some unknown way. In the same year some of the pole lines have been almost entirely rebuilt. The poles were of Norway pine and only lasted 6 years. The depreciation on the best pole lines is at least 8 per cent. The foot note shows that

the commission is beginning to learn that depreciation is a condition and not a theory; but even the revised 5 per cent. allowance on the steam plant is absurdly low.

Let us assume 7 per cent. as being a reasonable average rate and on that basis recalculate the cost of an arc lamp per annum. We use in this calculation the commission's figures for interest, lost taxes, and cash cost of operation.

Depreciation on $802,438.93 at 7%	$56,170.72
Interest at 4% on $721,861.56	28,874.46
Lost taxes	8,262.35
Cash cost of operation	99,087.16
Total cost	$192,394.69
Proportion charged to arc	163,343.09
Proportion charged to incandescent	29,051.60
Total cost	$192,394.69

Dividing the amount charged against arc lighting by the average number of lamps given in the report, namely, 2,133, gives $76.58 as the cost of an arc lamp. Dividing by the number 2,082, which is the true average number of lamps, gives $78.45 as the cost of an arc lamp for a year.

ANOTHER LOOK AT DEPRECIATION.

There is another way in which the commission's estimate of depreciation affects the accuracy of their report. They have been adding depreciation to their operating costs at the rate of 3 per cent. since they began to publish reports. On page 25 of the present report we find the following tabulation:

DEPRECIATION ACCOUNTS.

Debits.

To investment prior to June 30, 1897	$729,222.73
To investment during year to June 30, 1898	60,923.00
To investment during year to June 30, 1899	23,657.74
To investment during year to June 30, 1900	14,284.53
To investment during year to June 30, 1901	23,566.83
To investment during year to June 30, 1902	80,577.37
Total amount charged to investment	$932,232.20

Contra.

By amount added to cost of lights for depreciation prior to June 30, 1897	$40,145.73
By amount added to cost of lights for depreciation year ending June 30, 1898	22,500.00
By amount added to cost of lights for depreciation year ending June 30, 1899	22,534.71
By amount added to cost of lights for depreciation year ending June 30, 1900	22,287.22
By amount added to cost of lights for depreciation year ending June 30, 1901	22,325.61
By amount added to cost of lights for depreciation year ending June 30, 1902	24,073.17
Total amount added to cost of lights for depreciation	$153,866.44
Balance present investment June 30, 1902	$778,365.76

Let us figure depreciation at 6 per cent. instead of the ridiculous figure of 3 per cent. We then have:

Contra.

By amount added to cost of lights prior to June 30, 1897	$43,753.36
Year ending June 30, 1898	44,783.00
Year ending June 30, 1899	43,515.99
Year ending June 30, 1900	41,762.10
Year ending June 30, 1901	40,670.03
Year ending June 30, 1902	43,064.83
Total	$257,549.31
Balance present investment	$674,683.20

The use of 6 per cent. instead of 7 per cent. as a depreciation rate in our calculation is intentional. We think 7 per cent. is a reasonable figure, but to use that figure would reduce the present value of the investment below the face of the bond issue. Our illustration as it stands shows that the money which has been raised for the plant by direct taxation has probably only made good the impairment of the bonded capital instead of having, as the commission claims, added to the net value of the plant.

ADDITIONAL PROOF OF DEPRECIATION INADEQUACY.

The fourth annual report is the first one in which the amount of the annual appropriation asked for by the Public Lighting Commission and the amount actually allowed by the Board of Estimates is given. The amount allowed for the year ending June 30th, 1900 (see fourth annual report, pages 53-54 and 55) to be expended in "Extensions and Betterments" was $41,945. Part of the money was to be used in the purchase of generators of a combined capacity (apparently) of 500 kw. For the year ending June 30th, 1901 (see fifth annual report, pages 67-68) no money was allowed for extensions. For the year ending June 30th, 1902, the amount appropriated for "Extensions and Betterments" was $55,328 (see sixth annual report, pages 67-68). From the seventh annual report we learn that with part of this money two generators of a combined capacity of 775 kw were purchased.

On pages 11 and 12 of the fourth annual report the total capacity of the electrical machinery of the plant is shown to be 1,337.5 kw. We have seen above that appropriations had been made in two succeeding years for about 1,275 kw capacity in generators. Naturally we would expect to find in the power house of the Public Lighting Commission an electrical capacity of 2,612.5 kw. But the seventh annual report prints a list of generators, on pages 16 and 17, whose combined capacity is only 1,954.5 kw. If all the generators were bought for which money was appropriated, it is evident that there has been a great deal of "replacement" under the guise of "Extension and Betterment." If this money has not been expended for the purpose for which it was appropriated, it is in order to ask whether or not it has been used to pay the operating expenses of the plant.

Returning to the seventh annual report we find on pages 72 and 73 a statement of the amount of money allowed for the fiscal year ending June 30th, 1903. The amount appropriated for "Extensions and Improvements" is $82,200. Among the items are two generators of combined capacity of 800 kw. We understand that this machinery has already been contracted for. If this is the case the eighth annual report for the year ending June 30, 1903, should show a total capacity in generators of 2,754.5 kw.

To show what are considered as "Extensions and Improvements" by the Public Lighting Commission we give below an extract from the *Detroit Free Press* of February 3, 1903. These estimates are for the year ending June 30, 1904:

"The Public Lighting Commission last night passed the estimates for next year. The total amount to be asked for maintenance, operation and extensions is $231,829, or $45,654 more than was granted by the Board of Estimates for the present year. The chief increases are in these lines: Coal, from $22,000 to $40,000, and station wages, from $23,000 to $25,000. The estimates in detail are as follows:

OPERATING AND MAINTENANCE.

Buildings, track, dock, etc.	$1,100.00
Steam plant	2,700.00
Electric plant	1,600.00
Miscellaneous tools and machinery	1,000.00
Conduits	450.00
Towers and lamp posts	2,000.00
Arc lamps	3,300.00
Lines and cables	6,000.00
Salary and bonds, secretary and city electrician	3,670.00
Printing and stationery	600.00
Storeroom	1,300.00
Office expense	1,700.00
Engineering and drafting	2,850.00
Oils	1,100.00
Waste	350.00
Coal	40,000.00
Miscellaneous station expense	1,000.00
Station wages	25,500.00
Trimming and patroling	16,500.00
Carbons	9,000.00
Incandescent lamp renewals	2,600.00
Incandescent lighting expense	800.00
Globes and nets	1,800.00
Bags, belts, etc.	100.00
Belle Isle plant	1,300.00
Shop supplies	150.00
Surgeon and hospital	450.00
Relief for operating department	1,900.00
Total	$130,820.00
Increase of pay of 19 trimmers from $2 to $2.25 per day	1,733.75
Increase of pay of three dynamo tenders from $1.60 to $1.75 per day	164.25
Increase to three patrolmen from $3.25 to $3.75 a day	547.00
Increase of pay to one steam fitter from $2.75 to $3.25 per day for 304 days	152.00
Grand total for operating if increases are allowed	$133,417.00

EXTENSIONS AND IMPROVEMENTS.

500 lamps, new locations	$12,500.00
Work of installing a 100 lamps underground circuit	27,492.00
Work of installing 400 lamps on overhead lines	26,000.00
Increasing Washington Avenue condult capacity	1,275.00
Removing four towers and placing in outlying wards	800.00
Operating 250 lamps 9 months	7,707.50
Operating 250 lamps 6 months	5,137.50
Connecting service to three schools	2,000.00
Removing wires from police poles	500.00
For purchase of two lots on southwest corner Randolph and Atwater Streets	10,000.00
For 200 series inclosed arc lamps to replace Brush lamps now in use	5,000.00
Total for extensions and improvements	98,402.00
Grand total for all purposes	$231,829.00

INTEREST ACCOUNT.

As previously stated, $650,000 of the amount expended in building this plant was raised by the issue of 4 per cent. bonds, maturing in 30 years. These bonds are taken care of by the general sinking fund, and not directly by the Lighting Commission, but the effect on the taxpayer's pocketbook is exactly the same. Seeing that the lighting Commission does not claim the sinking fund as an asset, there is no occasion to discuss that feature of its finances.

The remainder of the investment has been taken from the tax levy each year, being practically an assessment on the stockholders of the plant, i. e., the taxpayers. But the average taxpayer expects his money to bring in rather more than 4 per cent. per year. Therefore, the cost of an arc lamp would be somewhat more than the amount given above, depending on each taxpayer's estimate of the earning capacity of his money. The citizens of Detroit, if our memory serves us right, were always willing to invest their money in the electric lighting business; but we never heard that they were disposed to invest it in that or any other manufacturing business on the inducement of a 4 per cent. profit.

LOST TAXES.

This is the third line in the commission's calculations of the annual cost of an arc lamp. Once before we called attention to the manner in which this amount is arrived at. The commission speaks of the probable assessed value. Surely the commission can obtain as a matter of courtesy from the tax assessors of Detroit an assessment of the Lighting Plant. There are other lighting plants in the country which would be pleased to settle for taxes on the basis of "probable assessed value" if they themselves were allowed to estimate the probability.

APPORTIONMENT OF CASH COST OF OPERATION.

Thus far in our review of this report we have followed the commission's plan of apportioning the total expenses between the arc and incandescent departments according to the output in each department. In the average plant this is approximately fair, but in this case the arc output is so large in relation to the incandescent output that an error is introduced.

An analysis of operating costs on pages 58 and 59, dividing the costs of generating current, etc., between the departments in proportion to the output, but charging trimming, lamp renewals and other expenses which belong solely to one department, direct to their respective departments, gives the following:

Arc operating expense	$86,490.01
Incandescent operating expense	12,597.15
Total	$99,087.16

$86,490.01 divided by 2,082, the true average number of lamps in use, gives $41.06 as the cash cost of operating an arc lamp for a year instead of the commission's figure of $39.45.

OPERATING COSTS.

We come now to an examination of the reported cash costs. This is made in terms of average number of arc lamps operated one year of about 3,744 hours. We find it necessary to refer again to our analysis of the Sixth Annual Report and to quote therefrom as follows:

"So far all our statements of expense have been on the basis of the commission's report, which is in terms of 2,000-cp arc lights operated for one year. It is now in order to inquire what the commission supplies to the City of Detroit as a 2,000-cp arc light. Such a light is generally understood to be one absorbing at the lamp terminals about 450 watts and utilizing about 435 watts in the arc. The commission's report, page nine, states that the total output of the plant for the year for arc lighting is 3,475,389 kw-hours. On the same page the average number of 2,000-cp arc lights is stated to have been 2,035. On page 24 the annual hours of burning are set forth as 3,729 hours 30 minutes. Multiplying the two latter, the figures give a result of 7,589,532 arc lamp hours. Using this as a divisor of the output for arc lighting, we find that the average power at the switchboard for each lamp is 458 watts.

"This will not do. The transmisson from the swtchboard to the lamps requires considerable power. The system being a series system throughout, it is possible to estimate the power required from the mileage of wire in use. A careful estimate shows that this power lost in transmission is about 9 per cent. of the total. This reduces the 458 watts at the switchboard to 417 watts at each lamp.

"Four hundred and seventeen watts per arc means inferior lighting. The lighting of Detroit several years ago in the early days of the plant was notably good, the current and the carbons being both what they should be. Observations on two occasions during the year just passed lead to the conclusion that either the current or the carbons, or both, are now inferior. The consumption of carbon in a night's run is less than it should be. The arcs in different lamps differ materially from one another, and, as a rule, are less brilliant than they should be, and we are satisfied that the power does not exceed the calculated 417 watts. If so, it would obviously be unfair to compare light for light, the street lighting of Detroit to-day with the street lighting of cities where contractors are compelled under watchful scrutiny, to give full measure of service."

This statement (with the exception of minor changes) holds true for the year covered by the seventh annual report. The watts per lamp at the switchboard and at the lamp were almost exactly the same in the year under examination as in the previous year. The service continued to be bad—so bad that had it been service by contract the commission could not have approved it. In this connection the following quotation is of interest:

Pages 32 and 34, Annual Report:

1901 Lamp hours out	1902	Increase
4,092.21	6,825.15	66%

This is the greatest number of lamp hours out in any year in the history of the commission, with the exception of 1898, when the trimmers' strike was in progress. The enormous increase in "lights out" is promptly explained by a look at the tables on page 41. The cost of maintenance for 1901 was $7.80 per lamp; for the year just passed, $5.73. The apparently frantic effort to keep down expenses has led to the neglect of the property of the Lighting Commission with a consequent lowering of the service.

EMPLOYEES.

We quote again from ELECTRICAL WORLD AND ENGINEER of February 15, 1902:

"It is an old failing of municipal boards to charge to construction account, when such an account is open, expenses that belong in maintenance. An examination of the list of employees in the maintenance department (page 36) leads to the conclusion that it is not excessively long, particularly when it is noted that the working day is only eight hours. The annual compensation of these 26 employees foots up $15,732.50; but the total expenditure for the year charged to maintenance account is but $11,288.67. Doubtless the men do not make full time. On the other hand, there must be rush repairs which make overtime. Allowing for these uncertainties, there remains a difference of $3,500 or thereabouts, to be explained. Men who ought to know say the difference covers time of these employees charged to construction, the excuse being that they were actually employed more or less on construction work. This excuse should not stand. If the plant were debarred from making any extensions these employees would necessarily remain on the pay roll and their pay would be charged to operating expense. Such a charge would add about $1.75 per lamp to the maintenance account of the plant."

Referring to page 40 of the Seventh Annual Report we find that the total maintenance and repair wages for 1901-1902 figured for 300 days are as follows:

1 Blacksmith	at	$2.75	$825.00
1 Blacksmith Helper	at	1.00	330.00
1 Carpenter	at	2.40	720.00
1 Painter	at	2.25	675.00
1 Lathe man	at	2.75	825.00
1 Steam fitter	at	2.75	825.00
1 Foreman lamp and cable dept.	at	2.75	825.00
3 Helpers in lamp room	at	2.00	1,800.00
1 Helper in lamp room	at	1.60	480.00
1 Helper in lamp room	at	1.75	525.00
1 Apprentice in lamp room	at	1.10	330.00
1 Apprentice in lamp room	at	.66⅔	200.00
1 Conduit man	at	2.75	825.00
1 Conduit helper	at	1.60	480.00
1 Line foreman	at	3.00	900.00
5 Linemen	at	2.50	3,750.00
1 Line helper	at	2.00	600.00
1 Ground man	at	1.75	525.00
Total			$15,440.00

But the total wages charged to maintenance and repairs in the report is only $9,715.48. There is a difference of $5,634.52, which we fear must have been charged to construction. We arrived at a similar conclusion last year and nothing to the contrary has been set forth. If our present conclusion is correct there should thus be added to the operating expense something like $2.25 per lamp.

It appears that even the stated cash cost of the Detroit street lighting cannot pass without challenge. The lighting is not such as would be accepted by the City of Detroit from a contractor as satisfying a standard specification for street lighting, so that the cost per lamp does not represent an equivalent to the cost per lamp of contract lighting. Further, it appears that part of the time of employees necessary for the maintenance and repair of the plant is charged to construction account under circumstances which may be amenable to explanation, but with the result that the apparent operating cost is reduced.

MISLEADING STATEMENTS.

There are several less important statements in this report which may be classed as misleading because they only half state or else incorrectly state the facts. For instance: On page ten the president asserts that the city is saved $1,200 each year by work performed by the City Electrician and his assistant, which formerly had to be paid for. Before the organization of the Lighting Commission the Chief Electrician of the Fire Department acted as City Electrician. In transferring part of his duties to the electrician of Lighting Commission the city has not gained financially.

On page eleven is found this statement: "Our arc lighting has been increased over 12 per cent. and the incandescent lighting by the unprecedented amount of 71 per cent."

This statement is misleading as the following tables show:

	1901	1902	Increase in Lighting
Arc lamps, average number operated as stated in annual reports	2035	2133	98 or 4.8%
Incandescent lamps connected	6948	11780	71%
Current used for incandescent lighting in 1901		497,961 kw-hours	
Current used for incandescent lighting in 1902		651,594 kw-hours	
Increase in lighting		153,633 kw-hours or 30%	

Another misleading statement is at the foot of page 24, where it is set forth that the investment cost to the City of Detroit of a 2,000-cp arc lamp is $263.35. We reprint the two tables which appear on page 24 as follows:

COST OF THE CITY LIGHTING PLANT.

The city's investment proportioned between the incandescent and the arc lighting on the basis of the electrical output, is as follows:

	Arc.	Incandescent.	Total.
*Conduits	$80,832.04	$14,342.59	$95,174.63
Cables	47,344.23	8,400.62	55,744.85
Real estate	53,612.21	9,512.79	63,125.00
Buildings and wharf	93,597.33	16,607.63	110,204.96
Lines and poles	147,638.66	26,196.57	173,835.23
Towers and lamp posts	97,981.00	.....	97,981.00
Electric plant, arc	71,164.23	.....	71,164.23
Electric plant, incandescent	.....	24,835.24	24,835.24
Steam plant	109,997.68	19,517.66	129,515.34
Railway tracks and scales	9,327.30	1,655.01	10,982.31
Machine shop	6,806.45	1,207.71	8,014.16
Arc lamp and switches	65,243.06	.....	65,243.06
Totals	$783,544.19	$122,275.82	$905,820,01
Belle Isle, lines, cables, lamps, etc.			26,412.19
Grand total			$932,232.20

* About one-quarter of these are occupied.

COST REDUCED TO A LAMP BASIS.

Reducing the above investment, exclusive of the Belle Isle, to the amount per lamp on the electrical capacity of the plant, viz.: 2,745 arc of 2,000 candle power, and 7,500 incandescent of 16 candle power, and we have the following:

	Arc.	Incandescent.
Conduits occupied	$7.36	$.48
Cables	17.25	1.12
Real estate	19.53	1.27
Buildings and wharf	34.10	2.21
Lines and poles	53.78	3.49
Towers and lamp posts	35.69	...
Arc plant	25.92	...
Incandescent plant	....	3.31
Steam plant	40.07	2.60
Railway track and scales	3.40	.22
Machine shop	2.48	.16
Arc lamps and switches	23.77	...
Totals	$263.35	$14.86

It will be noticed that the first table divides the investment on the basis of electrical output, while the second table gives the investment per lamp on the basis of the total capacity of apparatus in the possession of the commission.

The ordinary reader will assume that this $263.35 covers the investment necessary to maintain an arc lamp in the street. We expect, indeed, to see this tabulation made the basis of construction estimates by other municipalities. But the figure does not mean anything of the kind. Indeed, it does not mean any useful figure. It results from dividing the total investment by the total capacity of all kinds of machinery, old and new, good, bad and indifferent, in the possession of the commission. If the commission had on hand a few more idle arc lighting dynamos and lamps, having only a junk value, the figure would have been lower than it is. The maximum number of arc lights operated by the commission at any time during the year is reported as 2,302; not by any means 2,745. The commission is even now hastening additions to its arc lighting equipment, which it says it needs as a reserve.

Let us figure the investment per effective arc lamp from the first table as follows: The amount of investment in arc plant is $783,544.19. Dividing this amount by the *maximum* number of arc lamps operated at any time during the year, namely 2,302 gives $340.37 as the investment per lamp.

A DISCREPANCY.

There are some discrepancies in the report among which the following deserves notice: On page ten the president rejoices in the collection from rentals of $6,775.61. On page 66 the commission's secretary, and on page 70 the city accountant, show the collections as $2,786.53. This may be the difference between earnings and actual collections for the fiscal year, but in the estimate for the succeeding year published on page 72 the commission states that it expects to get only $3,525.

COMMERCIAL LIGHTING.

We find this year a positive recommendation by the president of the commission that the public lighting plant of the City of Detroit should engage in general commercial lighting. The president says that statistics show that he could place an 8-cp light in the humblest home at a cost of about ¼ of 1 cent per hour. Or if he were allowed to do commercial lighting and charge the going price per kw (we suppose he means kw-hour), he could light the city for nothing and have a handsome balance in the treasury at the end of each year. This statement would have greater weight did the report of the commission show that it was doing comparatively well in the work that it now does. Our analysis shows that a street light costs the City of Detroit not $63.82, as is reported, but not less than $80—probably more. Let us see what similar service by private companies costs in Detroit and vicinity.

COST OF SERVICE FROM PRIVATE CORPORATIONS.

The Edison Company, of Detroit, sells current for 16 cents per kw-hour for the first hour's use per day, and for 5 cents per kw-hour for all current used after that hour. The company at these rates furnishes and trims the arc lamps. Discounts on bills are from 10 per cent to 20 per cent. The commission's report shows that the city's street lights burned 3,744 hours last year. We will figure the cost of a 450-watt lamp burning this length of time at the Edison Company's regular rates.

365 hours x 450 watts = 164.3 kw hours at 16c	$26.28
3379 hours x 450 watts = 1520 kw-hours at 5c	76.00
	$102.28
Less 20 per cent	20.45
	$81.83

This cost is figured on the rates that would be given any customer who consumed enough current to make his bill $100 or more per month. The customer has the right to order out the service at the end of any year. It is fair to presume that with a long contract a much lower rate would be made to secure this desirable business. The city has virtually a perpetual contract with its public lighting plant.

The village of Highland Park, just north of Detroit, owns its own lines and lamp fixtures, but buys its current from a private company in Detroit. This company furnishes dynamo capacity, arc lamps and current; trims and cares for the lamps and maintains

fixtures and lines for $70 per lamp per year. A proper interest and depreciation charge on lines and fixtures owned by the village would bring this cost up to about $76 per year.

It appears by these figures that the Public Lighting Commission instead of being in a position to undersell the private companies, does not at present succeed in meeting their rates for arc lighting.

Let us see what the commission will have to do to meet the current rates for residence lighting. The following figures represent fairly the rates for residence lighting in Detroit:

Mr.———— Residence No. —— Jefferson Ave.
November 27th, 1901, to November 28th, 1902.

Kw-hours	Amount paid	Rate per unit	Per 16 c. p. lamp hour	Per 8 c. p. lamp hour
1866.4	$139.23	$.0745	$.003725	$.002135

Mr. ———— Residence No. —— Adelaide St.
December 24th, 1901, to December 20th, 1902.

Kw-hours	Amount paid	Rate per unit	Per 16 c. p. lamp hour	Per 8 c. p. lamp hour
644.6	$70.17	$.108669	$.00543	$.00326

In the foregoing figures we have assumed that a 16-cp lamp required 50 watts and that the 8-cp lamp which is to be placed in the humblest home requires 30 watts. The Public Lighting Commission is now doing some incandescent lighting.

COST OF INCANDESCENT LIGHTING OF PUBLIC BUILDINGS.

We have not discussed this department of the commission's work because the interest in it is comparatively little. The commission's figures, however, should serve to show what could be done if its system of incandescent lighting were extended to those humble homes. The published figures prove unfortunately to be as deceptive as those on street lighting. To begin with, and as already noted, the incandescent lighting of the station and of the commission's offices is reckoned as incandescent output, and it thereby serves to reduce the average cost per kw-hour. Such lighting is an unquestionable operating expense. If we cut this out of the incandescent lighting alone, we would have to readjust the distribution of expense between arc lighting and incandescent lighting. Next we have to consider the duplications in output records already noted. It results that we must figure on the entire output of the plant as stated in kw-hours.

The total kw-hour output is given in the report as 4,323,849. The arc total is arrived at by volt and ampere readings on the arc board, from which a constant is derived, and this constant is multiplied by the number of lamps in use.

The alternating total is obtained from wattmeter readings on the alternating switchboard. As nearly as may be estimated, at least 5 per cent. must be deducted from these figures for current used in operating the plant which should not be considered as output; or doubly reckoned as output, as we have already seen in reckoning the true number of arc lamps. Therefore, the true number of kw-hours is 4,117,556.

But this output is measured at the switchboard. In order to find the cost of supply at the place of use the intervening losses of energy must be deducted. It is safe to say that in this combined arc and alternating plant with long transmission lines and step-up and step-down transformers, these losses are at least 30 per cent. of the output. Therefore, the supply available for sale would be 2,882,359 kw-hours. We have seen that the total output costs $192,394.69. Therefore, the cost per available kw-hour is 6.7 cents.

We have assumed that the 8-cp lamp at ¼ cent per hour requires 30 watts. This equals a rate per kw-hour of 8⅓ cents, or 1.63 cent per kw-hour above the cost of producing the current. While it is true that the above cost contains the items that pertain exclusively to the street arc lamps, yet a plant engaged in commercial work must not only furnish and trim commercial arc lamps, but must have an increased force of office men, meter men and trouble men, over that employed in the Detroit Municipal Plant. Moreover, five-sixths of the current furnished by the Detroit plant now is used in arc lamps burning 3,744 hours per year. This is in direct contrast to the average commercial plant, which has to keep machinery in readiness for a demand that extends over less than 2,000 hours per year. It is clear to us that should the Public Lighting Commission engage in commercial work with proper provision made for a sinking fund and a depreciation account, not only would the 6.7 cent, but in addition the 1.63 cent, would be required to meet the cost of each kw-hour produced.

THERE IS NO VALUED INVENTORY.

We have discussed thus far the statements contained in the Seventh Annual Report of the Public Lighting Commission of Detroit and have endeavored to draw conclusions warranted by the experience of those who have learned the street lighting business most thoroughly. But the fact remains that the one thing which would make our investigation complete, namely, an inventory, is missing from the pages of this report.

No valued inventory of this property has ever been taken. The commission states that the plant has cost, in round numbers, $930,000; that $153,000 has been charged off as depreciation; and that the difference, or approximately $775,000, is the present value. We learn that they are now discarding $100,000 worth of machinery and lamps; and that one costly pole line has been practically abandoned, the aerial wires being replaced by underground cables. We know that, apparently, operating expense has been charged to construction. What we do not know and cannot find out by the report is the real value to-day of the property of the Public Lighting Commission.

The only way in which the commission can prove that the cost of an arc lamp per year is $63.82 is by having an unbiased expert make an inventory of their plant. If this expert will show in his report that the present value of the lighting commission's property is equal to the estimated value in the Seventh Annual Report, then the commission's conclusions are correct and the proper amount has been charged to depreciation each previous year; on the other hand, should the inventory show a less value than that given in the report, then ELECTRICAL WORLD AND ENGINEER's conclusions are correct that only a part of the operating expense has been accounted for each year, and that the remainder of these expenses must be met by the taxpayer at some future day, and we fear in a manner that must come as a very disagreeable surprise.

New York Central's Hotel.

The New York Central Railway Company plans to put up a big hotel at the Grand Central Depot, New York. The building is to comprise a large hotel containing more rooms than the Waldorf-Astoria, a department store, with a greater floor space than Wanamaker's, offices, besides all of the railroad facilities for its through and suburban trains, and with underground connections with the subway. These plans of the Central, and as to power, have been made public by Mayor Low at a meeting of the special committee of the Board of Estimate and Apportionment, which has had charge of the Park Avenue improvement. The committee report approves the plans outlined and several others. The New York Central agrees to begin work on the changes within 30 days after the proper legislation has has been secured, and agrees to substitute electricity or some other non-combustible agency for steam as a motive power below the Harlem. Relative to the change of motive power the report states: "Steam is forbidden on the whole of Park Avenue south of the Harlem River. The bill, as drawn, permits the use of steam in case of a breakdown of the new motive power, for a period not exceeding three days; and, for a violation of this provision, imposes upon the railroad a penalty of $500 a day after three days, unless meanwhile the railroad has obtained the certificate of the Mayor that the use of steam is further justified by the emergency. In view of the difficulty experienced this winter by the Manhattan Railroad Co. with its primary installation of electric power; and in view of the still more recent accident to the power house at Niagara Falls, your committee believes that such a provision for emergency is in the public interest. The clause in the bill relating to the emergency is so carefully drawn as to make abuse of it very unlikely."

Niagara Power in Ontario.

It is stated, so our Canadian correspondent informs us, that all the important municipalities within a radius of 100 miles of Toronto will co-operate in an effort to secure a Niagara Falls power concession at the approaching session of the Ontario Legislature. It is proposed to run trunk cables from Niagara Falls east as far as Toronto and west as far as London, Ont., and supply power to the different places along the routes. It is claimed that power can thus be obtained at a cost at least 50 per cent. lower than that of the present steam-produced electrical power in Toronto, which is $40 to $60 per horse-power-year.

The Construction of Aerial Telephone Lines--V.

BY ARTHUR V. ABBOTT, C. E.

IN last issue three tables were given, each presenting data for estimating the various items of cost in pole line construction. In Table 4, herewith, some examples of complete cost of pole lines are given—Tables 4, 5 and 6 being identical with Figs. 4, 5 and 6.

In this table two kinds of poles are shown—chestnut, pine—and two sets of curves are given, one for iron wire and one for copper. For both sets the height of poles is found on the lower horizontal scale reading from left to right for the iron wire line and from right to left for the copper wire lines. The total cost per mile is found upon the left-hand side of the sheet for iron wire lines, and on the right-hand side for the copper lines. The basis of estimating the total cost allows three standard ten-pin arms to a 25-ft. line, four to a 30-ft., five to a 35-ft., seven to a 40-ft., nine to a 50-ft. line, twelve arms each to a 55-ft., a 60-ft. and a 65-ft. line. Each arm is supposed to be fully equipped with a wire on each pin, but no knobbing is included. For iron wire lines No. 9 iron wire is assumed, and chestnut

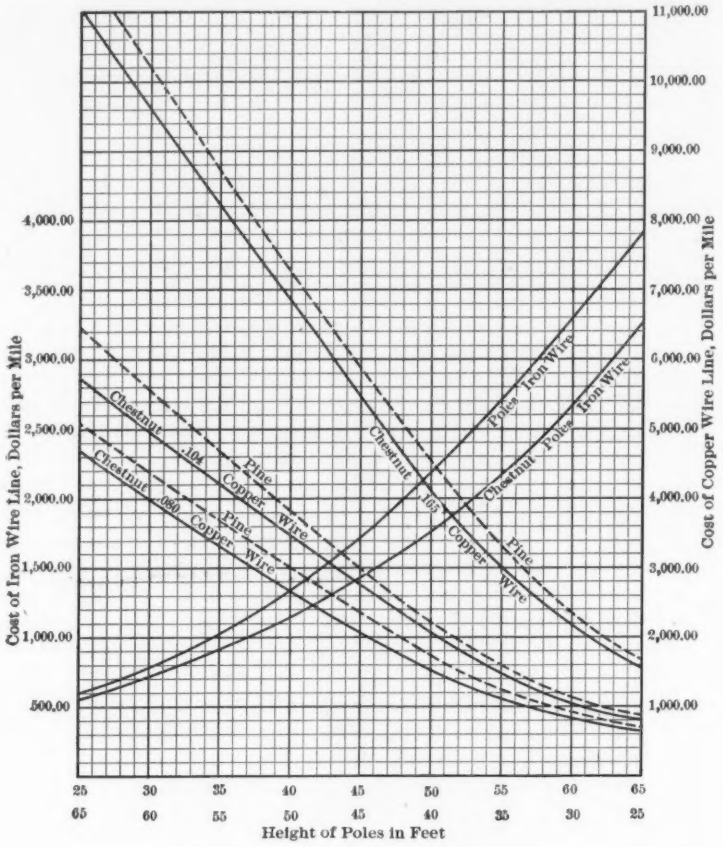

Cost of Iron Wire Line, Dollars per Mile
Cost of Copper Wire Line, Dollars per Mile
Chestnut .104 Copper Wire
Pine .104 Copper Wire
Chestnut .080 Copper Wire
Pine .080 Copper Wire
Chestnut Poles Iron Wire
Pine Poles Iron Wire
Height of Poles in Feet

FIG. 4.—COMPLETE COST OF POLE LINES.

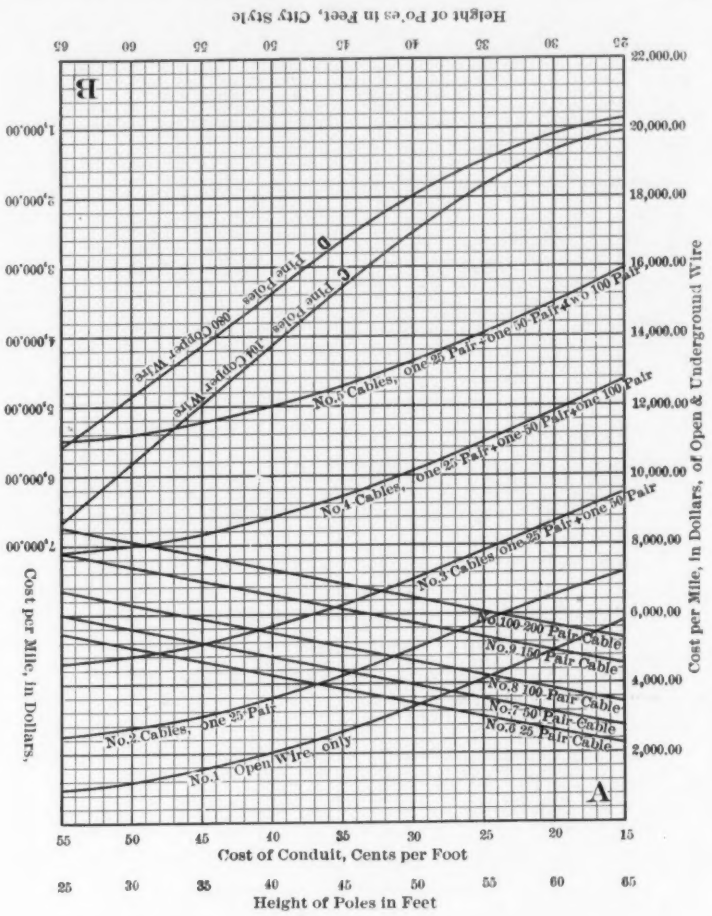

Height of Poles in Feet, City Style
B
C Pine Poles .080 Copper Wire
D Pine Poles .104 Copper Wire
No.5 Cables, One 25 Pair + One 50 Pair + Two 100 Pair
No.4 Cables, One 25 Pair + One 50 Pair + One 100 Pair
No.3 Cables, One 25 Pair + One 50 Pair
No.100 200 Pair Cable
No.9 150 Pair Cable
No.8 100 Pair Cable
No.7 50 Pair Cable
No.6 25 Pair Cable
No.2 Cables, One 25 Pair
No.1 Open Wire only
A
Cost per Mile, in Dollars.
Cost per Mile, in Dollars, of Open & Underground Wire
Cost of Conduit, Cents per Foot
Height of Poles in Feet

FIG. 5.—COMPARATIVE COST OF AERIAL AND UNDERGROUND LINES.

poles. For the copper wire lines three sets of two curves each are shown, one for .080 B. & S. copper, one for .104 B. & S. and one for .165 B. W. S. For each size of wire a curve for pine and a curve for chestnut poles is shown.

In Table 5 a comparison between the cost of aerial and underground lines is made. Holding the sheet with *B* in the lower right-hand corner the lower scale is height of poles in feet and the right-hand scale is the cost per mile of entire line using pine or cedar pole. There are two curves—*C* for .104 copper and *D* for .080 copper. Holding the table so that *A* is in the lower right-hand corner, there are on the bottom of the sheet two horizontal scales, one devoted to the height of poles in feet, reading from left to right, while the other is the cost of conduits per duct foot from 15 cents to 55 cents, reading from right to left. The cost per mile of completed line of either kind, is found on the right-hand scale. Ten comparative curves are shown upon this sheet. No. 1, headed "Open Wire Only," gives the total cost per mile for lines carrying only open wire and no cable. No. 2 includes one 25-pair aerial cable, No. 3 one 25-pair cable and one 50-pair, No. 4 one 25-pair cable, one 50-pair and one 100-pair, and No. 5 adds a second 100-pair cable. Curves Nos. 6, 7, 8, 9 and 10 give the cost per mile of cable installed in conduit of various prices as per the lower scale. Thus a mile of 100-pair cable in conduit at 20 cents per duct foot will cost $3,900—$39 per circuit mile. The cheapest open wire line to carry 100 circuits would be a 30-ft. line with three cables and three cross arms, and would cost $8,000, or $80 per circuit mile. On the other hand, a 25-pair cable in 35-cent conduit will cost $3,940 per mile, or $157.50 per circuit mile, while a 45′ open wire line will only cost $2,600—$105 per circuit mile. It is, therefore, obvious that when many circuits are needed, underground lines are by far the cheapest in original construction, to say nothing about decreased cost of labor, but when there are few circuits the open wire of aerial cable is the cheapest to install.

In discussing underground wire plant it was shown that it was impossible for many reasons to realize the full efficiency of all wire installed. Similarly with an aerial route there will be more or less of the pole and cross arm capacity that cannot be usefully employed. Insulators and wire can be more closely controlled than is possible with any form of cable, for only as many insulators and as much wire need be erected as can actually be put in service. Thus the working efficiency of the pole line is somewhat greater and the conduit or aerial cable, and in large exchanges carefully planned, 85 per cent. efficiency has been achieved. Taking probable inefficiency into consideration, Table 6 gives a comparison between underground wire plant, aerial cable and open wire on the circuit mile basis. On the bottom of the sheet there are two scales, one reading from left to right, showing the number of pairs per cable, applicable to both aerial and underground cable; the other from right to left for open wire. The left-hand scale shows the cost per available pair mile for all kinds of wire plant. There are three sets of curves. The full lines show the cost of underground wire in cables from 20 to 200 pairs. There are four curves, one for conduit of 4 ducts, one for 8 ducts, one for 12 ducts and one for 16 ducts; the cost of these various sizes of conduit being the same as shown in the article on "Conduit Construction." The dotted curves on the left hand of the sheet give the cost of aerial cable on 30-ft., 40-ft., 50-ft. and 60-ft. pole lines; the cable cost being that shown in the paragraphs on the "Cost of Aerial Cable." On the right hand of the sheet there are five "dot dash" curves, giving the cost of open wire on 25-ft., 30-ft., 40-ft., 50-ft. and 60-ft. pole lines, calculated by the data of this section.

These curves show very conclusively that when from 25 to 100 circuits are needed the aerial cable is the cheapest form of wire plant so far as original cost only is concerned. For less than 25 circuits the open wire line is cheaper, while when there are more than a hundred circuits underground conduit is cheaper. But this comparison applies only to original cost.

In succeeding paragraphs it will be shown that the annual cost of maintenance and depreciation is for all forms of aerial line at least twice as great as for underground, to say nothing of the more reliable service rendered by the latter. Suppose now that a telephone company builds its plant from the proceeds of a bond issue, bearing say 6 per cent. interest. To cover depreciation and maintenance on underground plant, 7 per cent. per annum must be allowed, while on an aerial plant 19 per cent. is necessary for the same items. The total annual charges will then be 13 per cent. for the underground

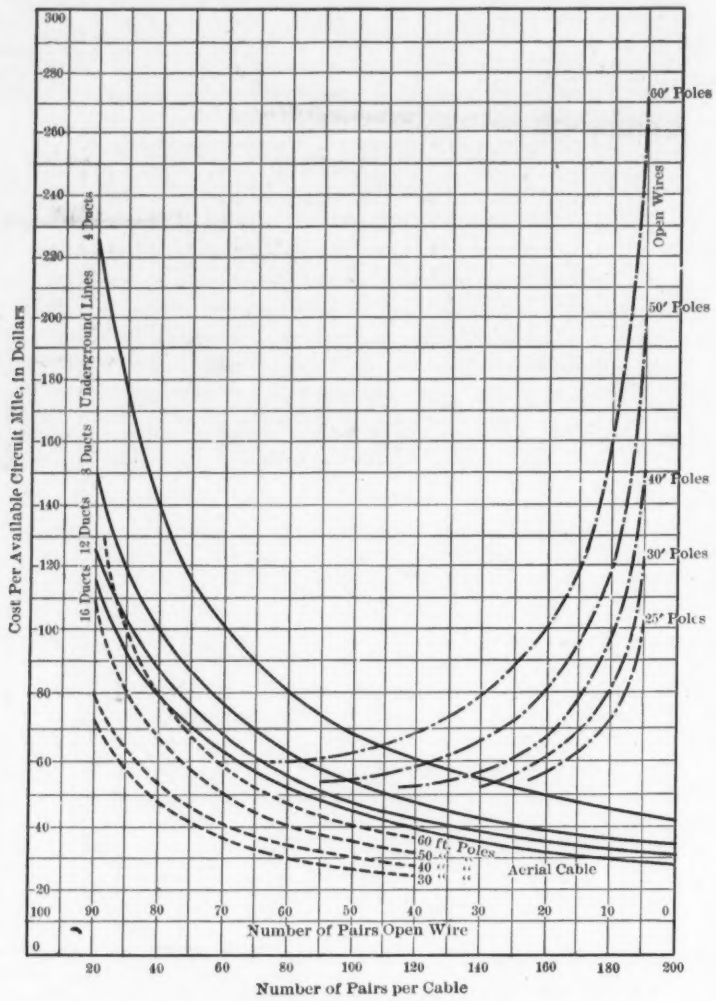


FIG. 6.—COMPARISON BETWEEN UNDERGROUND WIRE PLANT, AERIAL CABLE AND OPEN WIRE PLANT.

plant and 25 per cent. for the aerial, and hence about $200 can be invested in underground plant to every $100 in an aerial one, and make annual expense exactly the same. In any such calculation it is impossible to valuate the additional advantages to accrue from the better service that the underground system offers in securing an immunity of interruptions to subscribers, to which the aerial line is always liable. Subscribers are better satisfied; there is no lost income from telephones out of service, etc., none of which can be estimated in dollars and cents. For such reasons, therefore, it is safe to assume that whenever during the lifetime of the plant more than a hundred circuits may be expected the underground plant is the cheapest and best in the long run.

ANNUAL EXPENSE.

The annual expense of open wire lines is more variable and higher than on any other item in the telephone plant, for the pole line is subjected to a greater number of destructive forces, and those of greater intensity than any part of the plant.

Depreciation.—The causes producing depreciation are four: 1st. The gradual rotting of all the woodwork. 2nd. The growth of the territory served, so that sooner or later the pole line capacity is exhausted beyond the possibility of increase. 3rd. The constantly increasing demands of city authorities to substitute underground conduit for open wire. 4th. The sleet storm.

1st. *Decay.*—Experience has shown that the rotting of poles takes place close to the ground level, within about a foot above and below it, where the pole is most exposed to air and moisture. Few forms of preservative treatment, except creosoting, seem to have any sensible retarding effect on the rot, and on the average poles must be replaced in about 8 years. Cross arms and pins last longer, though the point of attachment of the arm to the pole is a weak spot and soon rots. The base of the pole is also constantly exposed to all sorts of extraneous attacks; the impact of wheels, the nibbling of horses, the mischievous ingenuity of the street urchin; all conspire to shorten the life of the pole.

2nd. *Growth of Territory.*—Increase in the number of subscribers has a marked effect on the depreciation of pole lines. A certain number of subscribers is estimated for a given territory, but within a few years this number has possibly quadrupled. By no possible means can the original line be made to carry so great an increase; either a new line must be built on the old route or the new plant must go underground; in either case the old line must bear entire depreciation.

3rd. *Change in City Requirements.*—The regulations of all cities are each year growing more and more hostile to the employment of open wire, and almost universally the telephone companies are being urged to go underground, or to enlarge the territory of the underground plant they already have. This becomes a very potent cause of depreciation. Fifteen years ago there was little wire underground; now few cities will tolerate aerial lines except in the outskirts, and even the smaller towns are pushing toward the underground goal.

4th. *Sleet Storms.*—But of all the forces that prey on the open wire line the sleet storm is the most destructive, and most to be dreaded. No winter passes that does not wreck many miles of telephone and telegraph wires; few in which the havoc is not widespread; and the telephonic isolation of some of even the larger cities is more than occasional. Witness the "big storms" of 1888 and 1890 in New York and New England, and those of 1895, 1896 and 1900 in Chicago and St. Louis. A few specific instances may be of value. In the sleet storm of February last one telephone company operating along the Atlantic coast lost not less than $250,000, while five companies in Pennsylvania and New Jersey suffered more than $300,000, and about the same time so far south as Lexington, Ky., half of the poles in the country went down. Mr. Ellicott, city electrician of Chicago, reports a storm last March that required seventy-five miles of new wire; and the author has a very vivid recollection of a couple of sleet storms that cost a telephone company in the aggregate at least $60,000.

When all these items are carefully considered, in the light of experience over a considerable period of time, it is found that an allowance of 12.5 per cent. on first cost is the least that can be considered fair for open wire lines. It is probable, nay certain, that as large a percentage is not needed every year, but unless unexpended balances are carried to "Deferred Depreciation" the time comes when a very few hours' work of the wind will not only wreck the pole line, but wreck the treasury in the absence of such a safeguard.

MAINTENANCE.

The annual maintenance of aerial lines is equally onerous. Cross arms rot, insulators pull off, or boys break them with a rifle ball. A falling tree branch may tear open half a dozen lines. An extra frosty night will pull a lot of lines out of the McIntires, or even rupture the wire itself. A fire alone may be the knell of many circuits, for firemen are ruthless when a pole opposes the hose. Even a waste-paper basket fire will spoil all the aerial cable in a pole line, for the lead melts like butter under the least blaze. The ordinances of many towns contain provisions requiring the removal of lines to permit of house moving, for which the owner does not always pay. While even copper wire from its inoxydizable qualities is seemingly immune from maintenance, it yet falls sometimes a prey to those in whom enterprise is greater than their respect for the commandments, for there are instances recorded where many miles of working circuits have been stolen. For these and divers other reasons the maintenance of aerial lines will average at least 6 per cent. on original cost.

A Unique Electric Light Plant.

By L. B. CHERRY.

AN electric plant operated by hot water is the latest development in the Far West, and forms the subject of this article. Thermopolis, Wyoming, is the scene of this novel achievement, and it may be of interest to give a brief history of the town and the Big Horn Basin Hot Springs, which are so potent in healing and at the same time are the source of power for an electric lighting plant.

In 1897 the Government purchased a tract of land 10 miles square from the Indians, and donated one mile square and the hot springs

FIG. 1.—VIEW OF SPRING.

to the State, the remainder of the tract being thrown open to settlement. Just across the Big Horn River from the springs the town of Thermopolis was laid out, and soon contained a number of fine cut-stone business houses and hotels. The State has built a $10,000 steel bridge across the river, and laid out a park ½ mile square, which will be set with trees and shrubbery next summer. The State has also built a free bath house of cut sandstone, and this, with a plunge bath house and sanitarium makes Thermopolis a health resort second to none in the Far West.

There are several large hot springs along the river, and from the river bed hot springs bubble to an extent that for miles the river

FIG. 2.—VIEW OF PORTION OF FALLS.

never freezes over, thus making it an ideal stream for water power. The waste water from the largest of these springs is used by the Thermopolis Electric Light & Power Company for power. Fig. 1 shows the spring, which is a hot, seething pool 20 ft. in diameter and so deep that it has never been fathomed. Sulphurous gas and steam are released at the surface, the effect of which gases is to impart a bluish tinge to the water. The temperature of the water is 138° F. The volume of water is 750 cu. ft. per minute, with a head of 48 ft. available for power. Fig. 2 shows part of the water as it falls over a beautiful snow-white formation into the river 48 ft. below.

In the construction of the power house, a room 16 ft. by 24 ft. was excavated from the solid rock formation next to the river just to the left of the view represented in Fig. 2, and to gain access to it, one must go down a stairway to the river and land on a natural porch overhung with stalactytes tinged with many colors.

Fig. 3 gives an idea of the exterior of the plant. The equipment at present consists of a 30-kw., 1,100-volt Westinghouse alternator, belted to a 13-inch "American" turbine of the horizontal type. Owing to the steam and gas which the hot water gives off when being

FIG. 3.—VIEW OF EXTERIOR OF PLANT.

agitated, the turbine had to be placed as near tail-water as possible to get the full value of the power, as otherwise the steam and gas would have partly filled the draft tube.

A small street car line will be put in next summer to carry passengers to the springs, which are one mile from town. When the present plant becomes too small, a power will be developed in the river, where 1,000 hp can easily be obtained. The company will then have power to sell for irrigation, and for the operation of coal mines which are only a few miles out of town.

Gold and nickel were recently discovered while boring a well, and should these metals prove to exist in paying quantities electric power for the mines will probably be furnished.

Revenues of Wireless Telegraphy.

In regard to the expenses and revenues of wireless telegraph work, Mr. Marconi is quoted in a recent interview by a representative of Dow, Jones & Co., the financial news agency, as follows:

"I am informed that the cost of installing a transatlantic cable approximates $4,000,000, and that the cost of maintenance and operation approximates 10 per cent., or $400,000 per annum. The cost of installing wireless stations, capable of doing an equal amount of business, is $200,000. On account of this much lower initial outlay, the relative cost of maintenance and operation is proportionately greater. I estimate it at 25 per cent., or $50,000 per annum."

"What do you estimate the earning capacity of such a station to be?"

"The maximum speed attainable with the present apparatus is 30 words a minute. We consider 18 words a good average at present, but with the perfection of the instruments we shall be able to maintain a higher average than even 30 words a minute. Estimating the present average is but 10 words per minute and the average price of transmission but 7 cents per word, the revenue would be $42 per hour, or $1,008 per day, or over $365,000 per year for each station. Our contract with the Canadian government binds us to a maximum charge of 10 cents per word for ordinary commercial service and 5 cents for government and press service."

"Can you give an estimate of the probable earnings from marine communication between ships and from ship to shore?"

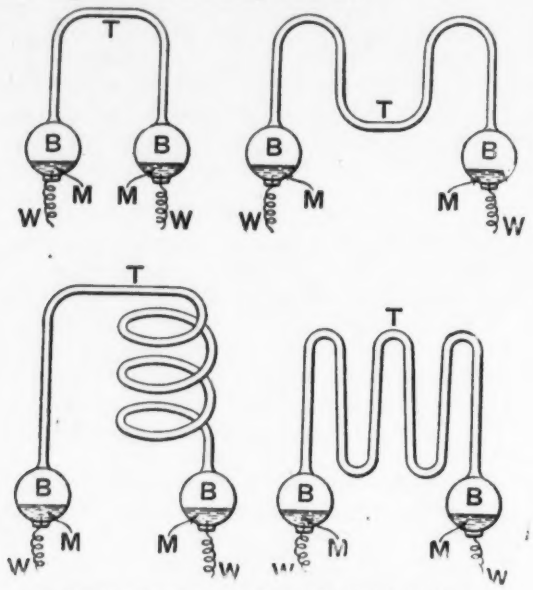
"The best answer to that is that the English Marconi Company has one contract which produces a revenue sufficient to pay 6 per cent. interest on the entire capitalization of the company."

The Mercury Vapor Lamp.

Mr. H. J. Dowsing, in a letter dated February 4, to the London *Electrician*, calls attention to a patent on a mercury vapor lamp (No. 4,261) issued to him in 1896. The firms engaged in the lamp industry at that date seemed, he says, to be very busy, and quite satisfied with carbon. "Now, however, that the mercury lamp has been shown to be practicable by the Americans, it might be possible to get such a patent taken up even by an English firm. I have learned, like many others, that the most likely source from which assistance could be obtained, or an invention even inquired into, is an American one.

"I may mention that after spending a considerable amount of time and money in making this mercury lamp, and not succeeding in getting it taken up, I became somewhat tired of paying the annual patent fees, and, having stopped same, the patent has now lapsed. Mercury lamps, therefore, can be made free of royalty by British firms, who will probably think they have gained something by not being too rash in taking up a new invention.

"Previous to my experiments which led to the making of this lamp, I had not heard or read of a mercury vapor lamp having been made. I was led to take up the matter by noticing the particularly brilliant spark obtained from the vapor of mercury when using a mercury brake. I usually employed a small transformer to take the current from the city circuit at 100 volts, increasing the pressure to about 2,000. Of course, the lamp only wanted starting, after which the pressure might be considerably reduced."



VARIOUS DESIGNS OF MERCURY VAPOR LAMPS.

In the succeeding issue of the same journal the specifications of the Dowsing patent are reprinted, from which we reproduce the accompanying cuts. A glass tube is employed of very small bore, such as is used for thermometers, into the ends of which are sealed leading-in wires to terminals within the tube. The tube is exhausted so as to produce a partial vacuum, and through it is passed an electric current, preferably alternating. In order to obtain a considerable area of luminosity, the tube may be bent into a coil or like form, the convolutions of which being near together present, when illuminated, a considerable area of light. It is found of advantage to put in the bulbs into which the terminals are sealed a quantity of mercury or of an amalgam of mercury with other metal. The accompanying illustrations represent various forms of lamps. In each case two bulbs, *B*, are connected by a small bore tube, *T*, which may be sent and shaped in various ways. Each bulb, *B*, contains mercury, *M*, lying on the end of a leading-in wire, *W*, which is sealed through the glass. When currents of high tension are supplied, the interior of the glass tube becomes highly illuminated. It is of advantage sometimes to warm the lamp before starting, so as to render the rarefied atmosphere within it more conductive by the presence of a little mercury vapor. The patent claim is as follows:

An electric lamp consisting of a glass tube of very small bore connecting two bulbs containing mercury which are connected by leading-in wires sealed through the glass to a source of high-tension electricity, the atmosphere within the tubes and bulbs being rarefied.

Telephone Cables and a Suggestion as to Unreasonable Specifications.

By Frederick J. Hall.

In an article on "Wire and Cable Specifications," published in the Electrical World and Engineer, December 13, 1902, the writer endeavored to show the impossibility of conforming to some of the rules of the National Board of Fire Underwriters for insulation resistance and pressure tests.

Impossible requirements, however, are not confined to these rules, nor to tests for determining the dielectric qualities of rubber compounds. The tensile and torsion tests required for hard-drawn copper by telephone companies is another example in point. A recent specification for 16 B. W. G. hard-drawn single-pair telephone cable, requires each wire to have a tensile strength of not less than 225 lbs. and to stand 45 twists in 6 inches.

Everyone at all familiar with copper wire, knows that to increase the tensile test is to lessen the torsion test. You cannot get the maximum of both tests from the same wire. These impossible requirements have come about by the assumption that if a short piece of wire can be made to stand certain tests, the same tests can be applied to the wire in commercial quantities. A wire is like a chain, only so strong as its weakest point. This is equally true when applied to tension, torsion, insulation resistance or pressure tests. In 1,000 ft. of chain perhaps a dozen links might be found that would show strength far beyond the average, yet no one would demand that all chains of that size and weight should show the same strength as those dozen links or be rejected as bad. If a 100-ft. length of 16 B. W. G. hard-drawn copper wire was cut into 5-ft. lengths, it is a safe gamble that no two pieces would give the same tensile or torsion tests.

Attention should also be called to the fact that telephone companies often issue specifications where the outside diameter is strictly limited and a certain insulation resistance is strictly required, without any regard whatever to the relaton one bears to the other. Under such conditions it is merely a question as to which requirement will be modified.

Nature endows her creations with definite properties. These properties man's ingenuity can modify to a certain extent; but his ability in this direction is strictly limited. When he attempts to go beyond this limitation he is—to use a slang expression—"up against it."

The troubles arising from manufacturers attempting to meet impossible requirements is largely their own fault. The remedy lies in their hands. If they had more confidence in each other, which would mean a freer interchange of ideas, these troubles would soon end. The condition for a long time has been simply this: Specifications imposing impossible conditions are given to a manufacturer. His protest is met by a statement that So-and-So has conformed to them or is able to. Instead of verifying this statement, the manufacturer courts failure by attempting the impossible. If, on the other hand, the relations between manufacturers were such that they would have no hesitation in conferring with one another on the subject, the result would be the elimination of impossible conditions.

Manufacturers are fully alive to the tough problems users of electric wires and cables are called upon to solve, and appreciate their anxiety to get the very best goods possible. They are always ready to go to the limit of their capacity in order to meet specifications, even when the requirements are far in excess of what would seem necessary to meet the conditions of service. But when a manufacturer attempts the impossible he is laying up trouble for himself and his customer.

Wireless Telegraphy Over the Pacific.

A telegram from San Francisco says wireless messages to Hawaii are to be sent soon from the Pacific coast, according to A. L. New, manager of the Pacific Wireless Telephone and Telegraph Company. "We have the machinery under way," he declared. "It now only remains to be decided whether Seattle or San Francisco shall be the terminus on this coast. We have constructed powerful dynamos, which will be adequate to send messages 3,000 miles. An intercontinental system is no more difficult of construction than two shore stations, and the last of our outfit is already built. We have sent messages a distance of 1,150 miles with the apparatus which we own and control."

A Discussion of Electric Automobiles.

At the meeting of the English Institution of Civil Engineers on January 13 Mr. J. C. Hawkshaw, president, in the chair, the paper read was "Electric Automobiles," by H. F. Joel, Assoc. M. Inst. C. E., who stated that, in London alone, there were over 16,000 licensed horse carriages, apart from private vehicles, tradesmen's vans, etc. It was estimated that over 200,000 horses were stabled each night in London, necessitating the daily removal of more than 5,000 tons of manure and refuse, in addition to what was distributed over the roads, and found its way into the residences of the people. The growth of London and other large cities made the problem of substituting motor cars for horse traction one of the first importance, and the object of the paper was to describe one form, possibly the most practical, and certainly the most interesting of all forms of motor car, the electric automobile. These had now become thoroughly practical vehicles, journeys of over 100 miles on one charge, and tours of over 1,000 miles (from London to Glasgow and back) having been satisfactorily accomplished.

The earlier experiences with various types of cars, etc., were first described, the information being tabulated as far as possible and the historical side of the subject being briefly dealt upon. It was only since the passing of the Locomotives on Highways Act, in 1896 that the problem of motor cars has been seriously attacked in England. In Germany, France, Austria, America, Italy, Spain, Belgium and many other countries earnest attention was being given to the manufacture and the perfection of electric vehicles, and in most of these countries inventors and designers were assisted by their governments directly by subsidies, by official trials as in Berlin, or otherwise. In England it had been left entirely to the enterprise of the private individual to compete with the foreigner for a share at least in this new and important industry, which even now gave employment to some 10,000 men in England. Tabulated examples of recent long-distance runs of carriages propelled by one charge were given, and these records were analyzed for comparison, elevations and plans of the carriages being shown to scale, and the disposition of the batteries indicated. As these were all special designs and not merely adaptations of carriages, they were instructive as examples.

Some very careful tests to determine the durability of storage batteries had been made by the Automobile Club of France in 1889, extending over 6 months, the results of which were given in the paper. The tests had been made under conditions analogous to those that would occur in the carriages in practical use. The sets of batteries had been equally charged with 24 amp at 2.5 volts per cell, but had been discharged at rates varying from 20 to 100 amp, with intermediate periods of rest, and whilst being discharged they had been subjected to artificial vibrations, to give the effect of road vibrations, and this treatment had been continued until the cells had shown signs of failure.

The ratio of weight of vehicle to weight of storage battery was next considered. Generally speaking, as the ratio of the battery to the vehicle increased, so the distance the vehicle could be run on one charge was increased. But of greater importance, from a practical point of view, was the load-carrying capacity, and ratio of the weight of useful load to the weight of the battery and vehicle. A battery of accumulators weighing 6 cwt would give 10 hp-hours, or 67.2 lbs weight of battery for 1 hp-hour, taking the efficiency of the motor and gear at 75 per cent. Assuming an output of 15 watt-hours for 1 lb of complete battery, such a battery would convey itself against a tractive resistance of 50 lbs per ton (or 1/45), at the rate of 12 miles per hour, for a total distance of 250 miles. If the vehicle to convey this battery weighed 6 cwt, the distance that could be run with vehicle and battery would be 125 miles; and with a load of 3 cwt (driver and passenger) the distance would, under the same conditions, be reduced to 100 miles, equal to 75 ton-miles. With twice the load, or 6 cwt, the distance of the run would be reduced 83.8 miles, but the ton-mileage would be the same; and with three times the load, namely, 9 cwt, the distance would be still further reduced to 71.4, also equal to 75 ton-miles. The cost of carrying the useful load would be, for the 3 cwt load, at the rate of 1.8 penny (3.6 cents) per ton-mile; for the 6 cwt load, 1.1 penny per ton-mile; and for the 9 cwt load, 0.9 penny per ton-mile. The conclusion would be that, as the load was increased, the cost of conveying the useful load per ton-mile was reduced; this was so, but the limit was soon reached when the vehicle must be made stronger and heavier to carry the increased load, and the running cost of the whole would be increased, as well as the first cost and the consequent allowance for depreciation and interest.

In America batteries were made which gave a very great output with a comparatively shortened life of the positive plates, and as these batteries were of comparatively small cost they could be entirely renewed, say, each year, and this had been stated to result in economy. The author considered that potentialities of electric propulsion of carriages on common roads were very great.

Laying of a Submarine Cable.

At the meeting of the New York Electrical Society on February 18, Dr. A. E. Kennelly, of Harvard University, and an honorary member of the society, lectured on "The Laying of the Mexican Government Gulf Cables." This is the first cable of American manufacture laid for a foreign government. Dr. Kennelly said that if all the cables now lying at the bottom of the sea were joined end to end they would measure 200,000 miles, or nearly as far as from the earth to the moon. The life history of the cable was shown by a series of lantern slides, from a view of the spool machines in the factory of the Safety Insulated Wire and Cable Company at Bayonne, N. J., to the final joining aboard ship in the Gulf of Mexico. The cable was 500 miles long, one inch thick, excepting near the shore, where it was twice that size, and weighed 1,300 tons. It was carried in four deep tanks in a Norwegian cable ship of 1,400 tons burden to Vera Cruz, and a partition cable house, which had been brought from the United States, was put together, and a two-mile length of the cable was towed ashore and dragged up to the house. The end at sea was joined to the cable on the ship, which then plied to Frontera, where another house was erected and the operation was repeated.

At Campeche serious difficulties were met. The water was very shallow for seven miles out to sea, and although the town had 19,000 inhabitants, it did not possess a steam launch or even a barge. A one-masted vessel was procured by the cable people, the mast was removed, and the coil of seven miles was stowed away in the boat. A schooner, with two masts, served as a tug. When this tug went too fast the sails were taken in and when it was becalmed there was nothing to do but wait. Eventually the end of the first long American cable was made fast at the cable house, which stands almost on the spot where the Spaniards first landed in Mexico 400 years ago.

In spite of the inclemency of the weather, there was a large audience, among which were many ladies. Representatives of all the prominent cable firms in the city were present and the splendid collection of cables recently presented to the society by the family of the late Cyrus W. Field was inspected with much interest.

Science Abstracts.

Our valuable contemporary, *Science Abstracts,* will in future be published in two sections, *Section A,* Physics, embracing light, including photography; heat, sound, electricity and magnetism, chemical physics and electrochemistry, general physics, meteorology and terrestrial physics, physical astronomy. *Section B,* embracing steam plant, gas and oil engines, automobiles, oil engine driven ships and launches, balloons and airships, general electrical engineering, including industrial electrochemistry; electric generators, motors and transformers, electrical distribution, traction and lighting, telegraphy and telephony. The subscription prices will be eighteen shillings or four and a half dollars for each section separately, including index; or for the two sections, thirty shillings, or seven and a half dollars. The American Physical Society is now joined with the Institution of Electrical Engineers and the Physical Society of London in the direction of the publication and has elected Prof. E. H. Hall, of Harvard University, as its representative on the publishing committee. In consequence of this arrangement, Section A will in future be received by all members of the American Physical Society. The American Institute of Electrical Engineers is also co-operating with the committee and taking special means to bring the publication to the notice of all their members, who will in future be able to obtain it at a reduced subscription rate through the secretary of the American Institute.

New Telephone Patents.

For some months past there have appeared at frequent intervals patents for various "receiver holders." These are all designed to supplement the everyday hook switch, forming a support for the receiver during conversation. In the patent issue of February 17 the latest device of this type is described in a patent granted to Arthur J. Briggs. This device, while embodying a few improvements over its predecessors, retains their inherent defect, which is of so grave a nature that it is probably fatal to the adoption of any such device by telephone engineers. This lies in the fact that such devices encourage the subscriber to leave the telephone off the hook, a practice which is even now, when every endeavor is made to make the hook the most convenient place for the receiver, a source of the greatest annoyance to telephone exchange managers.

This week a new type of antiseptic mouthpiece attachment appears. It consists of a wafer or disc of flexible elastic material, which is

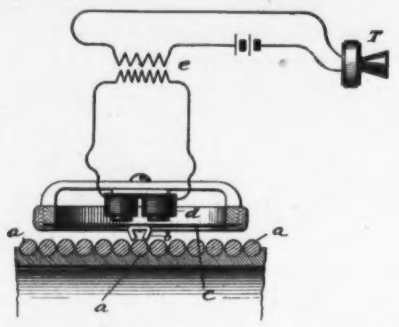


FIG. I.—ROSENBAUM TELEGRAPHONE.

treated with an adhesive gum having antiseptic qualities. In using the wafer, which is of somewhat greater diameter than the mouthpiece, it is slightly warmed, then centered upon the mouthpiece, when the projecting edge of the wafer is turned back over the edge of the mouthpiece, in which position it adheres. Mr. Charles W. Clough is the inventor of this device.

Under the title, "Apparatus for Electromagnetically Recording Speech," William A. Rosenbaum has patented an improvement in the apparatus known as the "Telegraphone." This apparatus is the invention of one Poulsen and affords means of recording for future reproduction any signals which are transmitted and received as electrical waves or impulses. In the Poulsen apparatus a steel wire or band is moved rapidly across the poles of an electromagnet somewhat similar to a receiver magnet, and connected in the receiving circuit. The arriving electrical waves, therefore, produce variations in the magnetization of this electromagnet exactly corresponding to themselves in characteristics, and these magnetic variations are recorded upon the moving steel strip. Reproduction of the signals may be made at any time by passing the steel strip over the poles of the recording or a similar electromagnet, having a telephone receiver connected to its windings.

With such an apparatus the volume of sound obtained in the reproduction has heretofore been rather minute, especially if the recorded waves have traveled a considerable distance. This is of course due to the almost infinitesimal energy available in the telephone receiver circuit. The present invention seeks to overcome this difficulty. Fig. 1 shows the method employed to do this. Herein *d*, the recording magnet, does not record directly, but serves to vibrate the diaphragm, *c*, which carries the recording magnet, the degree of magnetization recorded upon the steel at any instant being a function of the distance of the poles of the recording magnet from the steel strip. By this means, if the recording magnet is sufficiently powerful it is evident that a very diminutive wave received at *d* may record a very considerable magnetic counterpart upon the moving steel band. This invention appears a valuable addition to the telegraphone.

Pole changers for telephone ringing purposes have for many years received considerable attention as a ready source of ringing power for small central offices. One of their disadvantages has been the powerful primary battery necessary for their satisfactory operation. In a patent of the issue under consideration, granted to J. C. F. Malthaner, there is described what may be called a magnifying pole changer.

From a pivot near the yoke of a permanent magnet there is suspended an iron core surrounded by two windings, one of relatively few turns, of low resistance and terminating upon springs projecting at the free end of swinging core, and the other of many turns and terminating at the fixed end of the core where wires are led off from it to the ringing keys. The relative lengths of the permanent magnet and the iron core are such that the free end of the latter will swing between the poles of the former. Near the poles of the magnet are also arranged two sets of springs which are engaged by the terminals of the primary winding of the swinging core to form a reversing switch. A low-voltage battery being connected to the reversing springs and properly poled, the core will swing from side to side, producing an alternating current in the secondary winding, under the combined influence of the reversed primary current and the permanent magnet.

Both of the remaining telephone patents of the issue of February 17 are assigned by their inventors to the Kellogg Switchboard & Supply Company. Of these patents, one covers a "Self-indicating Operator's Key," which has been invented by G. L. Burlingame. In this, a ringing key, the cam lever is so arranged that a portion only of its normal motion is effective in operating the keys, this working portion of the stroke only being unstable. In other words, there is a lost motion between the two key operating positions of the cam, which will cause the handle to have an inclination toward the key last operated by it. This inclination of the handle serves as an indication to the operator of what signal was last sent out by any set of keys, of great service in case it becomes necessary from any cause to duplicate it.

The second of the patents above referred to provides an improvement in the Kellogg two-wire system, which is the work of Francis W. Dunbar. Fig. 2 shows the rudimentary circuits of the improved system, the details of the supervisory circuits being exactly as in the earlier system described in these columns a few months since. The present change in the system lies in winding the controlling relay differentially, the middle point being connected to a third conductor or ground as shown. By this means this relay is under better control during the operation of ringing, for the live side of the battery may be permanently connected to one of the windings of the relay irrespective of the ringing key, while any alternating current leaking across the relay has no effect upon it on account of the differential relation of the windings. This differential relation has no effect upon the operation of the relay by the battery when the ringing key is normal, as one of the windings is connected between two grounds and therefore carries no current. At first sight it would appear that the differential winding would cause a considerable shunting of the talking current by the relay. Mr. Dunbar states, however, that this may be and is overcome placing the windings upon opposite ends of the core and not superimposing them.

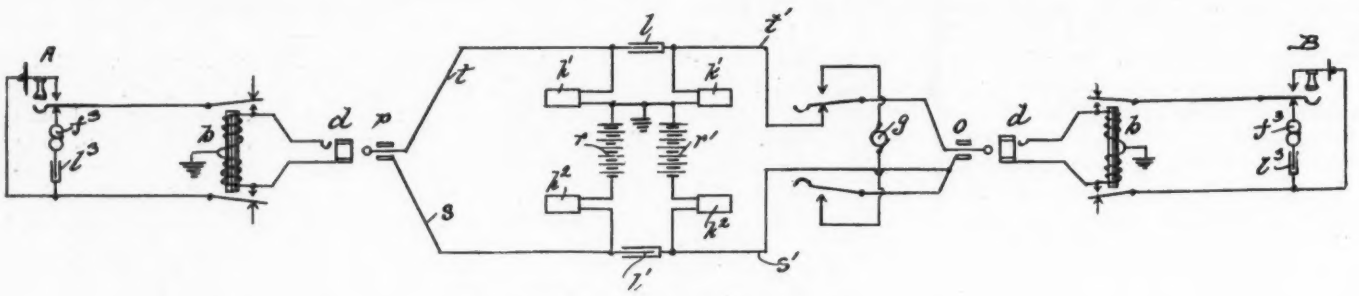


FIG. 2.—DUNBAR TELEPHONE SYSTEM.

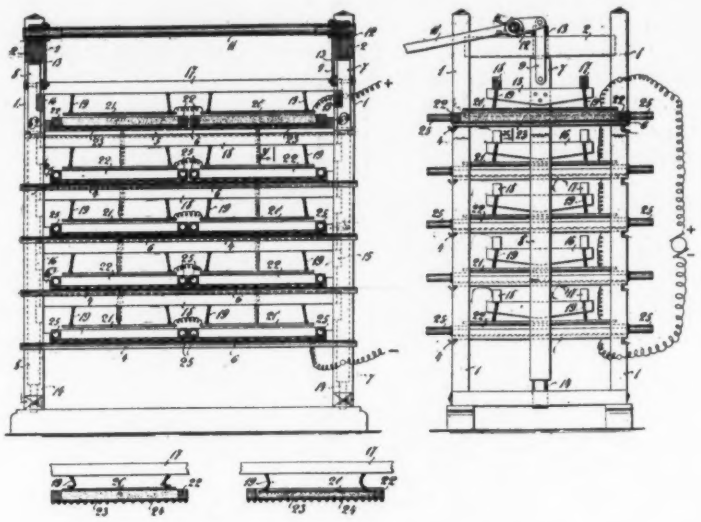
Extraction of Moisture by Electricity.

BY CLINTON PAUL TOWNSEND.

A patent recently granted to Dr. Botho Schwerin, of Berlin, covers an apparatus for carrying into effect his methods, heretofore described in these columns (Vol. XXXVIII, page 942), for drying peat and extracting moisture from various other substances by "electro-osmose." The method depends upon the well-known fact that liquids, and particularly liquids of low electrical conductivity, are transported from the anode toward the cathode under the influence of a strong electric current; if the liquid in question is in the form of moisture saturating a non-conductor, the latter may be interposed as a diaphragm between the electrodes, and the effect of the current will then be exerted in forcing the moisture from it, the cathode being preferably perforated to provide for its free discharge.

The latest construction is shown herewith in side and end elevation, the uppermost trays or cells appearing in section. Wooden side frames, 1, 2, with appropriate cross frames, support a superposed series of shallow trays, 6, the bottoms of which are of corrugated sheet metal. Within these trays rest the cathode boxes, 22, for receiving the peat or other material from which the moisture is to be expelled, the bottoms of these boxes being permeable, and illustrated as formed of copper or iron wire net, 23, supported by heavier net, 24.

As shown, two of these cathode boxes are supported side by side in each tray and connected electrically in parallel through the corrugated bottom of the tray. Above each cathode box an anode plate,



APPARATUS FOR EXTRACTING MOISTURE BY "ELECTRO-OSMOSE."

20, 21, of iron is suspended by chains, 19, from transverse beams, 17, 18. These beams are supported upon short cross bars, 15, 16, secured to vertical side bars, 7, 8, which in turn are hung by links, 9, from a cross bar, 11, and are free to move vertically in upper and lower guides, 13, 14. By means of a lever, 10, the beams, 17, 18, together with the several anode plates, 20, 21, suspended therefrom, may be moved upward into the position shown in the figures to permit the cathode boxes to be moved into place. The anode plates are then lowered into operative position in contact with the material in the trays, the chains, 19, being slack in order that the plates may follow the decreasing bulk of the material as the moisture is expressed.

The electrical connections will be clearly understood from the sketch: the anodes in each horizontal series are connected electrically in parallel, whereas the several superposed cells are series connected. Handles, 25, are provided for convenience in moving the cathode boxes and troughs, 4, for carrying away the expressed moisture.

A confusion of terms in the patent specification renders the data as to power required somewhat blind; it would appear, however, that the fall of potential through each cell is about 15 volts, and that about three hours' operation suffice for the removal of 40 to 50 per cent. of the contained moisture from peat. The current density is stated as 4 amp (per am²?) at the beginning, falling to 2½ amp as the operation proceeds.

The Chicago Electrical Association Meetings.

A somewhat different plan of meetings from the usual will be followed by the Chicago Electrical Association in its spring programme. Every other meeting will take the form of an entirely informal dinner at the Albion Café, Pullman Building. After each dinner a paper or short address will be given. The dinner feature will give a chance for social intercourse between members and friends not offered by the regular meetings.

The following programme has been announced: March 6 at the Albion Café (Pullman Building), dinner at 6, followed at 8 by an address on "Middle West Engineering: an Optimist's View," S. G. McMeen, engineering department, Western Electric Company. March 20, at 1736 Monadnock Building, "Telephone Service," S. J. Larned, general superintendent, Chicago Telephone Company. April 3, at the Albion Café (Pullman Building), table d'hote dinner at 6, followed at 8 by a paper on "Effects Produced by Grounding the Neutral on an Alternating-Current System," G. M. Eastman, in charge of testing laboratory, Chicago Edison Company.

CURRENT NEWS AND NOTES.

MARCONI'S ITALIAN CONTRACT.—According to a dispatch from Rome, the contract between the Italian Government and Mr. Marconi for the establishment of wireless telegraphic communication with the Argentine Republic was signed on February 16.

RAILWAY TELEGRAPH SUPERINTENDENTS.—The twenty-second annual meeting of the Association of Railway Telegraph Superintendents will be held at the St. Charles Hotel, New Orleans, La., May 13, 14 and 15. A large and enthusiastic gathering is expected.

TELEPHONE IN GERMANY.—It is stated that the telephone can no longer be legally used by German physicians in dictating prescriptions to druggists, because of the chances of fatal misunderstandings. Only in urgent cases, to save life, is its use in this manner allowed.

NIAGARA POWER IN TORONTO.—An offer has been made by the Hamilton & Lake Erie Power Company to the mayor of Toronto to deliver 30,000 hp of electrical energy in Toronto at $20 per horse-power-year. The company offers to provide energy at Jordan, Ont., at $10. It is stated that the company intends to obtain the power by connecting the Chippewa River and the Jordan.

EARTHQUAKE WARNINGS.—A method by which warning of earthquakes may be signaled by the combined use of the seismograph and the telegraph was explained by Prof. Lippmann at the recent meeting of the Academy of Sciences in Paris. The elasticity of the earth's surface is such that the slightest seismic shock may be transmitted to the furthest end of the world. Prof. Lippmann would take advantage of this to unite all the observatories having seismological instruments by telegraph wires so disposed that when the first seismic impression should be received, as usual after an earthquake, all the other apparatus connected would signal the earthquake's approach, for the electric current moves more quickly than seismic waves.

WILKINSBURG ELECTRIC CLUB.—The spring programme of the Electric Club of Wilkinsburg, Pa., illustrates the excellent work which this organization is promoting aside from its social function. During the spring there will be general or technical lectures each Monday and Thursday evenings. On Tuesday evenings there will be classes in direct-current apparatus, C. H. Darrell, chairman; elementary electricity, R. D. De Wolf, chairman; switchboards, B. Hour, chairman; railway work, L. Watts, chairman. Wednesday evenings, lectures on drawing; alternating-current work, D. F. Rogers and A. F. Jones, chairmen; transformers, W. H. Thompson, chairman; testing, E. M. Olin, chairman. Friday evenings, elementary electricity, W. D. Cassin, chairman; transformers, W. P. Woodward, chairman; detail apparatus, T. S. Perkins, chairman; road engineering, F. P. Woodbury, chairman. On the third Saturday of each month there will be a visit to places of technical interest under the guidance of F. P. Newbury, chairman.

WIRELESS NEWSPAPERS.—Copies have been received in this city of the first Marconi "Wireless" newspapers printed on board the Cunarder *Etruria.* Several leading items of the news of the day are given in brief, intelligible form, well condensed, and there seems no good reason why such bulletins should not constitute a regular part of an ocean voyage.

INSTITUTE NOMINATIONS.—We are requested by Mr. W. Stanley to say that having learned that he has been put in nomination by many friends for the presidency of the Institute, he begs that the nomination be withdrawn. While appreciating deeply this honor, he feels that he could not at this juncture give to the office the time and attention it would require, should it be his good fortune to be elected.

REGULATION OF STEAM-DRIVEN DYNAMOS.—A patent issued February 17 to C. E. L. Brown, of Baden, Switzerland, describes a device for regulating dynamos driven by steam engines or turbines. The piston rod of a regulating cylinder fed with steam through a pipe from a point in the engine where the pressure varies as to load, is geared with a toothed quadrant on the arm of a rheostat, the resistance of which is in circuit with the field of the dynamo driven by the engine.

PARIS UNDERGROUND PROSPEROUS.—On the first section open of the Paris Metropolitan Railways the number of passengers carried in 1902 was 62,122,728, and the receipts 10,761,677 francs, an increase of 13,644,612 in the number, and of 2,413,392 francs in the earnings. Yet the construction of metropolitan railways was delayed for twenty years from apprehensions that Parisians would never consent to travel underground in the dark. Electric lighting has offset that objection, as the carriages and stations are brilliantly lighted. The traffic is already congested during certain hours of the day.

CARNEGIE INSTITUTION GRANTS.—The Carnegie Institution, through President Gilman, formerly president of Johns Hopkins University, has made five grants of money to Johns Hopkins men to assist original researches. Two of these were announced by President Remsen lately as follows: To Dr. Harmon N. Morse, professor of Analytical Chemistry, $1,500 for an assistant in his researches upon the new method he has evolved for measurement of osmotic pressures. Dr. J. B. Whitehead, in the physical department, has received a liberal grant to carry forward a research in the theory of the magnetic field developed by Maxwell, the English scientist.

TRANSIT PROJECTS FOR NEW YORK.—Further plans for improving transportation conditions on Manhattan Island and in Greater New York generally have been prepared by Mr. W. Barclay Parsons, chief engineer of the Rapid Transit Commission. It is proposed to spend $50,000,000, half of which would be expended by the city. The plans include a new subway down Broadway from Forty-second Street to the Battery southward, and another on the east side from Park Avenue and Fortieth Street up to the Harlem River at Mott Haven; both connecting into the earlier subways now partly finished. Third tracks and double-decking part of the elevated system are also proposed at needed points, and one important item is the running of through New York Central trains to the Battery. Mr. August Belmont, representing the interests in control of the Manhattan Elevated and Subway systems, is in agreement with these new plans.

ELECTROLYTIC DIAPHRAGM.—A patent issued February 17 to Hugh Rodman describes a porous electrolytic diaphragm for use in any electrolytic work requiring an inert highly porous durable diaphragm. An inert gum, such as rubber, gutta percha, etc., or a gummy mixture, such as crude rubber and sulphur, is mixed with a soluble substance, such as an alkali sulphate. This material is fashioned as desired, then vulcanized and the process finished by soaking the hardened jar or diaphragm for four or five days in running water, which will take out all traces of the sulphate. Potassium sulphate is recommended for the process. It is stated that the material so made is strong, light and has the appearance and smooth surface of ordinary hard non-porous rubber. It offers, however, very little resistance to electrolytic action through its pores, while at the same time it practically stops any diffusion other than that due to electrolysis.

MUNICIPALISM IN MASSACHUSETTS has been given a setback by the recent opinions of the Supreme Court of that State adverse to municipal trading. These opinions were in response to legislative inquiry whether a city or town might, within its constitutional powers, buy and sell wood and coal for the benefit of its citizens. To the several forms in which this question was presented the answer was entirely adverse. The court was divided on the question whether in a time of great emergency a municipality might be justified in buying fuel at wholesale and selling it at retail, even though such trading might be outside of its constitutional rights. One judge, however, was not content to leave the matter thus open, and filed his opinion that no emergency can make constitutional an unconstitutional act. The general ground was that the constitution did not contemplate empowering municipalities to raise money by taxation for commercial purposes.

STANLEY WATTMETER.—Three patents were issued February 17 to William Stanley on a wattmeter for direct and alternating currents, in which the shunt coil is mounted to swing on pivots, and a time-beater employed to pass current intermittently through an integrating magnet and a coil which actuates mechanism for the release of a detent short-circuiting the shunt coil at the end of stated periods. The principal elements of the apparatus consist of, first, a time-beater or a device for accurately producing a given value of motion or given rotation of a wheel in a given time; second, an electrodynamometer or device for accurately expressing by its torque the value of energy transmitted through it from instant to instant; third, an integrating system or arrangement for accurately recording the sum of the torque values developed by the dynamometer in terms of time. Thus, for example, the torque developed during a given period may have a value expressed by the length of a spring required to balance it and may, therefore, be expressed in inches. The number of such inches per hour would, therefore, represent the value of the energy transmitted per hour, and the term "inch-hours" would be equivalent to "watt-hours" multiplied by a constant.

LETTERS TO THE EDITORS.

Mr. Hewitt and the Mercury Arc.

To the Editors of Electrical World and Engineer:

SIRS: I wish to thank you for your courtesy in calling attention to my work on the vapor lamp in your recent editorial under the head of "The Mercury Arc."

Prior to Mr. Westinghouse becoming interested in my work on vapor lamps, I had negotiations with officials of the General Electric Company with a view to their becoming interested in the inventions. These negotiations extended from 1898 well on into 1899, when they terminated, as no agreement was reached. My work was shown them and their experts in my laboratory, Mr. Steinmetz being present as one of their experts at their request. If I remember correctly, Mr. Steinmetz then said that the lamp was efficient and I am glad to note in reading his article that upon further investigation he has found no reason to change his view. At the time of these negotiations, no patents had been issued to me.

A public exhibition to illustrate the principles involved in my lamps was made by me on April 12, 1901, at the Conversazione of the American Institute of Electrical Engineers, at Columbia University, at which the fundamental relations of current to the vapor column were demonstrated by experiments.

NEW YORK CITY. PETER COOPER HEWITT.

Arrangement of Power Stations for Operating Steam Railways Electrically.

To the Editors of Electrical World and Engineer:

SIRS: Referring to article on power stations for operating steam railways electrically, presented in your issue of February 14, I assumed the central station method of distribution a paying investment for street railways from the fact that it is so generally used, and confined my attention to showing that the advantages gained

would not apply to steam railroads. As for the load factor, the storage batteries are intended for equalizing the load on the generating machinery, and I took particular care to make the point plain that, with the proper use of storage batteries, the load factor on one station supplying part of the load can be made equal to the load factor on a central station. I proposed a battery plant between generating stations for the reason that storage batteries may be economically installed in smaller units than the generating machinery.

Regarding the collection of large currents, I did not mention this subject for the reason that I did not consider it at all difficult. The collecting shoe in its present crude form cannot be expected to perform heavy service. No more difficulty should be experienced in collecting a heavy current by means of a contact shoe than in collecting a heavy current by means of a dynamo brush from the dynamo commutator. It can only be a few months before someone will make a shoe with carbon contacts and expend the same amount of ingenuity and workmanship on this as on other parts of the railway equipment.

C. J. SPENCER.

NEW YORK, N. Y.

[Our correspondent does not seem in the least to realize the very great difficulties of collecting large currents from a third rail. The shoe question has kept our best engineers guessing for the last five years, and is no nearer a practical solution than at the beginning. The best shoes work pretty well most of the time, and that is about the most that can be said of them. For moderately heavy work, when the third rail can be kept well insulated and free from obstructions of every kind, the system works well, but even now its limitations are being seriously felt. In our opinion the only hope of heavy long-distance electric traction lies in a large increase of the voltage at the working conductors.—EDS.]

Recuperating Exhausted Dry Batteries.

To the Editors of Electrical World and Engineer:

SIRS: It might interest some of your readers to learn that ordinary dry batteries, after being "spent" and abandoned, can practically and with little or no trouble or expense, be repeatedly recuperated as good as new. Some two years ago I discarded several dozen fluid cells of various makes and substituted dry batteries, on account of their superiority with respect to cleanliness, small size and other advantages. After several had become exhausted I adopted the following method for their recuperation:

One cell was connected in series with a single 16-cp, 110-volt lamp, using the latter for illuminating, as its brilliancy was not perceptibly decreased by the slight voltage drop. After about one hour the cell was disconnected, and on being tested proved to be as strong as when new. At another time groups of cells joined in multiple were connected in series with a ventilating motor, and still another lot were coupled all in series in connection with an electrolytic bath; every cell was recuperated and seemed in every respect as good as new, life and efficiency included. In the two years' time most of these cells have in this manner been recharged several times, and only three abandoned, the latter from want of attention.

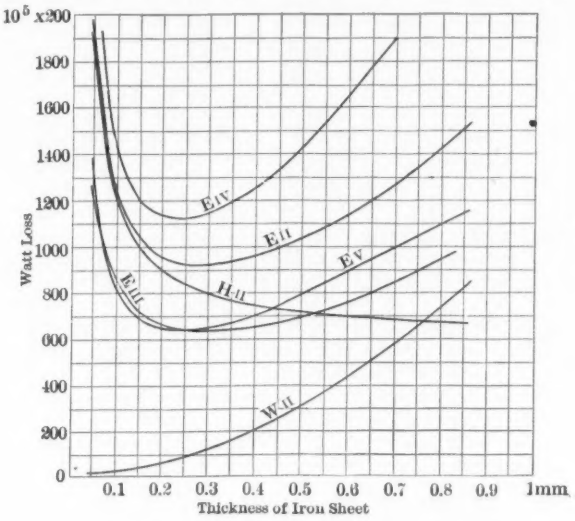
W. A. SHERLOCK.

SAN FRANCISCO, CAL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Thickness of Transformer Sheet Iron.—KAMPS.—An article on the most favorable thickness of sheet iron for transformer cores. The total loss in a transformer core is the sum of the hysteresis and the eddy current losses. The eddy current loss is proportional to the square of the thickness of the sheet iron and becomes smaller, the thinner the sheets. At the same time, if the thickness of the sheets would be continually decreased, the volume required for insulations would also decrease, and, in the same total space, less



VARIATION OF LOSSES IN SHEET IRON.

space is now available for the iron, i. e., the useful cross-section filled by iron is smaller, so that, in order to have the same flux of lines of force, it is necessary to increase the induction. Hence, while the thickness of the iron sheets is diminished, the eddy current loss decreases and the hysteresis loss increases; for a certain thickness of the iron sheets the total loss becomes a minimum. Whether this thickness should be chosen for practical transformer design, is a question to be decided in each case by economical considerations; but it would surely be a mistake to use in practice thinner sheets of iron than indicated by his formula. His formula states that the most favorable thickness in millimetres is 79 times the third root of a quotient, the numerator being the product of the coefficient of hysteresis and the thickness of insulation, and the denominator being the product of the frequency and the 0.4 the power of the induction which would exist in the case of an entirely solid iron core.

The thickness of insulation between sheets is assumed at 0.05 mm; he then determines the best (i. e., minimum) thickness for various frequencies; it is 0.34 mm for a frequency of 25 and an induction of 10,000; it is 0.30 mm for a frequency of 50 and an induction of 5,000; it is 0.24 mm for a frequency of 140 and induction of 2,000. The adjoining diagram shows the variation of the watt loss for varying thickness of the sheet iron; the four curves, *E*, refer to the total loss, *II* to a frequency 50, induction, 6,000; *III*, frequency 50, induction 5,000; *IV*, frequency 100, induction 4,000; *V*, frequency 100, induction 3,000. The total loss in the case *II* is separated into its two parts, the hysteresis loss being represented by curve *H* and the eddy current loss by curve *W*. From further discussion he concludes that a thickness of 0.3 mm might in general be considered as normal for transformer sheet iron; a greater thickness would be justified only, either by exceptionally high values of the coefficient of hysteresis and of thickness of insulation, or by exceptionally low values of frequency and inductions.—*Elek. Zeit.*, February 5.

REFERENCE.

Heyland Machines.—HEYLAND.—The conclusion of his very long illustrated article, the first parts of which were abstracted recently in the Digest. He describes a three-phase winding, mainly used for compound machines, each phase consisting of four parts in parallel, which are connected to two stars and to two triangles. He then summarizes the various windings used for compound machines; all arrangements are illustrated by diagrams; their description cannot be given briefly. He then gives some details of the design of machines built by various firms, the general method of construction being quite uniform. He finally makes some remarks on large low-speed machines.—*Elek. Zeit.*, February 5.

Lights and Lighting.

REFERENCE.

Ship Lighting.—Broadbent.—The first part of an article in which he discusses the best system of ship lighting, the arrangement of the plant and the wiring. In the present part he discusses the best place of the generating plant, the choice of governors, steam and exhaust service, and the construction of dynamos, switchboards and fuseboards.—Lond. *Elec. Rev.*, February 6.

Power.

REFERENCE.

Gas Engines.—Graham.—A long abstract of a paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. and of the discussion which followed, on the design of gas engines for special use in electric lighting stations.—Lond. *Elec. Rev.*, February 6.

Traction.

Electric Road from Fayet to Chamounix.—A description of this line, which is 19 km in length, with a maximum grade of 9 per cent., and is owned by the Paris-Lyons Mediterranean Railroad. The track is laid with 35-kg rails; the center rail is for emergency braking purposes. The so-called "third rail" is placed outside of the track and is supported by paraffined wooden insulators mounted on the ties. There are two generating stations each using water power; the equipment of these stations, which is thoroughly described, includes 200-kw direct-current generators, which have a series field winding and are also separately excited so that the voltage remains constant, independent of the speed of the generators. In one station an additional automatic short-circuiting device for the generators has been installed. The shafts of the motors are parallel with the rails and are connected to the axles by means of double gearing. There is an elastic coupling between the shafts of each motor and the axle which it drives. Trains are run by means of the multiple unit system in which the controllers are operated by pneumatic power.—*St. R'y Jour.*, February 7.

Ohio.—An article on Southern Ohio interurban improvements. Several electric lines in Southern Ohio have been absorbed in the Southern Ohio Traction Company and a traffic arrangement has been made with other lines entering this territory. During the last few months extensive improvements have been made including extensions of the lines, new equipment and additional power plant facilities. The company now has a direct connection between Cincinnati and Dayton, the principal point on the road being Hamilton. There are also several branches from the main line. The company has developed a very considerable freight business, and has also a well-organized express department. The company operates an electric freight locomotive and also uses single freight cars and combination express and passenger cars.—*St. R'y Jour.*, January 31.

Relation of Interurban Electric Railways to Steam Roads.—Wyly.—An article in which the rapid development of the interurban electric railway and the improved facilities which it offers are considered as well as the influence which its development has had in increasing the public travel. It is contended that the electric interurban extensions have materially benefited the steam railways in spite of the fact that much of the suburban traffic of the old lines has been taken by the new electric system. It is pointed out that this is not an unmixed evil as the steam trains are ill adapted to this class of service. This is now recognized by many steam railway managers who are encouraging the development of the electric lines as feeders to the steam trunk lines, and in some instances have substituted electricity as a motive power for suburban and branch roads.—*St. R'y Jour.*, January 31.

REFERENCES.

A Suspended Electric Car.—An illustrated description of a novel type of bridge which is being built across the Mersey River, in England. The span is about 1,000 ft. The car itself is about 55 ft. long by 24 ft. wide and is propelled by four electric motors.—*St. R'y Jour.*, January 24.

Shop Practice on the Grand Rapids, Holland & Lake Michigan Railway.—The method is first described of clamping babbitt in armature bearings while it is being machined in a lathe, so that it is not dragged out of place by the tool. A description is then given of a clamp for tightening commutators; this consists of an annulus or ring made of different parts which dovetail into each other. The ring is slipped over the commutator and then compressed by screws which bear on each segment of the ring, forcing the commutator to take a true cylindrical shape.—*St. R'y Jour.*, February 7.

Automobiles.—The first part of an article on the automobile exhibition at the Crystal Palace in London. Although the electrical exhibits are comparatively few, yet they are more numerous and important than at any previous exhibition in England. A list is given of the 49 exhibits of electrical automobiles or of electrical apparatus for automobiles.—Lond. *Elec. Rev.*, February 6.

Installations, Systems and Appliances.

Polyphase Work in 1903.—Eborall.—An article in which he discusses the lines along which polyphase work will probably develop. The single-phase system has not found such an application as its advocates had hoped for; on the contrary many single-phase systems have been converted to direct-current distribution with polyphase transmission. The conversion of high frequency single phase to standard frequency two phase, which involves no scrapping of existing feeding and distributing systems, is a logical development. He thinks, however, that the two-phase system should be limited to converted systems, because the old concentric cables can be used with it; for new schemes it presents no advantage over the three-phase system, while in certain respects, such as in the copper economy, the latter system is superior. He thinks the general system of the future for new work outside the sphere of pure direct-current working, will be three-phase transmission and distribution for lighting and power at a standard frequency of 50 cycles, with converting sub-stations for the street railways. Regarding frequency, he recommends using either 25 cycles for pure railway and tramway work in which synchronous converters are used in sub-stations, or 50 cycles for general lighting and power work. He regrets that for one of the largest schemes now in course of construction, namely the Yerkes underground railways, a new frequency has been introduced, namely 33⅓ cycles. It is still undecided whether the compromise of 40 cycles, to be used both for general work and for the operation of synchronous converters, is thoroughly satisfactory; on the one hand it is the lowest frequency which can be used with success for general lighting and motor work, being inferior to 50 cycles in these respects; on the other hand, it is yet to be proved that synchronous converters can be operated from a 40-cycles circuit in a manner which will fulfill the stringent requirements of the present day. The author prefers 50 cycles and the use of synchronous motor generator tramway sub-stations. There is at present little prospect of three-phase street traction. A standard uniform system should be used for street railways, i. e., the present 500-volt, direct-current system should be used in extensions. However, for light railways and for long, high-speed lines, the three-phase equipment, even as it stands to-day, will fulfill the requirements in a perfectly satisfactory manner and will come to the front in the near future. In both cases the continual starting and stopping is not required, and the question of acceleration is of minor importance; in both cases the provision of sub-stations containing running machinery for feeding the overhead conductors, would also be altogether too costly. The article is to be concluded.—Lond. *Elec. Rev.*, February 6.

Charging for Electricity.—Bastian.—An article in which he discusses the different methods of charging for electricity. The two-rate system, whereby a high rate is charged during the period of maximum load on the generating plant, and a lower rate at all other times, possesses the advantage that the cost of production can be taken into account by fixing the high rate at a figure that will cover the standing charges in the plant installed; in addition the system can easily be explained to the layman. In the latter respect it is superior to the maximum demand system, while the Hopkinson method of charging appears inadmissible for the sound commercial reason that it tends to restrict the number of electric lamps installed. The best possible tariff cannot be regarded as in any way a permanent solution of the charging problem, as all of them must be based on existing conditions. For comparison he refers to the fact that the peak of the load curve of some provincial gas companies is attained between 12 noon and 1 P. M., owing to the cooking stoves in use and the introduction of electric light; but nobody could have foreseen this ten years ago. The conditions of electricity supply will also undoubtedly vary. He thinks it to be inevitable that the ultimate system of charging must be the simple "flat rate," with a discount on a sliding scale according to the number of units consumed; therefore, the policy of the electrical engineer must be to endeavor to reduce the cost of production and increase the efficiency

of the lamps. A special charge for street railway lighting could be arranged, but this should be the only exception to the strict "flat rate."—Lond. *Elec. Rev.,* February 6.

REFERENCE.

Electrical Industry in Spain.—A statistical note stating that at the end of 1901 there were in Spain 859 electric plants, 648 of which were for public and 211 for private purposes. The oldest plant, in Santa Catalina, was opened in 1878; but nearly all plants which are now in operation were built during the last six years. In all cities of Spain which have electric light, there are used for public lighting 87,112 incandescent lamps and 1,470 arc lamps, and for private lighting 1,237,836 incandescent lamps and 2,819 arc lamps.—*Elek. Zeit.,* February 5.

ELECTRO-PHYSICS AND MAGNETISM.

Spontaneous Ionization in Air.—PATTERSON.—An account of experiments in which he endeavored to determine the cause of the so-called spontaneous ionization in air. To measure the spontaneous ionization at different temperatures, the air was contained in an insulated iron cylinder containing about 13 litres, and the rate of leak was measured between the walls of the vessel and an insulated electrode. This electrode was connected to one pair of quadrants of a very delicate electrometer and the rate of leak observed. The experiments showd that from the temperature of the room (20° C.) to about 500° C., the current through the gas was constant, the air in the cylinder being at atmospheric pressure throughout the investigation. To measure the ionization at different pressures the same cylinder and electrode were used. The joints were made air-tight with sealing wax and the air filtered through glass wool. The results showed that down to a pressure of about one-third atmosphere the current through the gas was independent of the pressure and that for pressures below 90 mm of mercury the ionization was proportional to the pressure. The results of the experiments indicate that the spontaneous ionization is really due to easily absorbed radiation from the walls of the vessel.—*Proc. Cambridge Phil. Soc.,* Vol. XII, No. 1; abstracted in Lond. *Elec.,* February 6.

Light and Cathode Rays.—ZEHNDER.—A description of some new effects of cathode rays and light rays. Many salts are known to be colored under the influence of cathode rays, and to lose their color subsequently when exposed to light. The author has found that if an object is traced on a dry plate by means of cathode rays and the plate is subsequently exposed to light, it may happen that after development the portion illuminated by the cathode rays appear brighter than the rest, thus recalling the effects of solarization. "Celloidine" paper, once exposed to cathode rays, becomes less sensitive to the effects of light. If the paper is then exposed to diffuse white light, that portion becomes darker which was not previously exposed to the cathode rays. It is thus possible to obtain a negative of a positive image produced by cathode rays. Solio and other papers show similar effects. A circular patch exposed first to cathode rays and then to light, first becomes paler at the margin, where the cathode rays were presumably less active, and gradually the brightening extends to the center. A fixing bath bleaches the cathode-exposed portions much quicker than the light-exposed ones. Magnetically-deflected cathode rays have the same effect as ordinary ones.—*Ber. Deutsch. Phys. Ges.,* No. 1, 1903; abstracted in Lond. *Elec.,* February 1.

Magnetic and Electric Deflection of Cathode Rays.—STARKE.—An account of an investigation of the reasons of the change of cathode rays due to reflection and transmission. It was formerly supposed that cathode rays suffer no change by reflection and transmission except in direction; but Gehrke and Leithaeuser have shown that a reflected or transmitted cathode beam is heterogeneous, and will be drawn out into a sheaf by an electric or magnetic field, although the same field is quite powerless to split the beam before reflection or transmission. On the electron theory, it might be supposed that it is either the ratio of charge to apparent mass of the cathode rays that is altered, or their velocity. The present author has made some experiments to test which of these alternatives is true; and finds that the latter is correct, as the ratio of charge to mass is unaltered, while both reflections and transmissions have the effect of considerably reducing the velocity of some of the cathode rays.—*Ber. Deutsch. Phys. Ges.,* No. 1, 1903; abstracted in Lond. *Elec.,* February 6.

Magnetic Friction in Gases.—PELLAT.—An account of experiments in which a strong magnetic field was brought to bear upon a vacuum discharge and more especially upon the positive column; as the latter is squeezed together into a thin pencil, the phenomenon is called "magneto-friction." He used a tube 1 meter long and 1.7 cm wide. As the magnetic field increases, the anode light contracts until it becomes a thin pencil. This halo gradually increases until it obscures the central pencil, and finally the magneto-friction disappears, leaving the gas as if no field existed. The point is reached much sooner in hydrogen than in oxygen. With a field of 7,000 units, the diffusion is complete in hydrogen under a pressure of 1.3 mm. Oxygen still presents a sharp pencil, but this may be made to diffuse by reducing the pressure to 0.13 mm. Mixtures of gases have intermediate properties.—*Comptes Rendus,* December 29; abstracted in Lond. *Elec.,* February 6.

REFERENCE.

Potassium Amalgam Cathodes.—LYMAN.—An account of an investigation of the action of sodium or potassium amalgums as cathodes in an exhausted discharge tube.—*Proc. Cambridge Phil. Soc.,* Vol. XII, No. 1, 1902; abstracted in Lond. *Elec.,* February 6.

ELECTRO-CHEMISTRY AND BATTERIES.

Alloying of Metals as a Factor in Electroplating.—KAHLENBERG.—An article pointing out that when one metal is deposited electrolytically upon another, the process of alloying always goes on to a greater or less extent, which is determined primarily by the nature of the metals, and secondarily by the conditions of the experiment. Among the latter are of special importance the original condition of the surface of the cathode, the nature and concentration of the electrolyte, temperature, potential and current density. The alloying power of the electrolytic deposit with the coated metal underneath is a factor determining not only the strength with which the deposit adheres, but also the length of time the plated article will wear and resist corrosion. The alloying power of two metals is a tendency to dissolve in each other; it is a force no doube chemical in nature. The stronger the affinity of the metals for each other is, the better the deposit is apt to adhere. On the other hand, the plating is also more apt to be absorbed by the base metal underneath, the greater the tendency of the metals to alloy. This is illustrated by various examples from practice. The electroplater must study the subject carefully so as to plate those metals or alloys upon each other that possess sufficient affinity to coalesce well, and yet will, at the temperatures at which the plated objects are to be kept, diffuse but very slowly into each other; he will also choose the color of the metals or alloys so that the final alloy formed may have the same, or nearly the same, shade as the electrolytic deposit and will itself be corroded less readily than the base metal alone.—*Electrochem. Ind.,* February.

Accumulator Plates of Slabs.—LEIMER.—An article on the manufacture of such plates; they are claimed to have the advantage over the Planté and the Faure type of a very high capacity per volume and a relatively low weight, and that they are strong and light enough to be used for traction purposes. They require very careful treatment during their manufacture; he found phenole in aqueous solution to be suitable for a binder; it forms a basis phenylate with lead oxides; in alcoholic solutions it does not answer. The plastic mass must be handled with due rapidity and the plates should be perforated at once; they are left to dry at least 12 hours, after which they are put into an oven. They are then placed into the acid bath, where they remain only for a certain time. Great precautions seem to be necessary in all stages of the process. The article is to be concluded.—*Centralbl. f. Accum.,* January 1.

Electrometallurgy of Iron and Steel.—RUTHENBURG.—An illustrated article in which he first gives figures for the power used in various electric iron processes: for one ton of metallic iron Stassano requires 3,000 hp-hours, De Laval 3,500 hp-hours, and Rossi 4,800 hp-hours. He remarks that for such measurements a recording wattmeter should always be used. He also thinks that the cost of power in a large steam plant with 1,000-kw or 5,000-kw units, and a fair quality of coal and with the facilities of a large plant, puts the prices now asked by prominent water powers very much in the shade. In his own iron process he needs only 500 kw-hours to produce a ton of products. As to the economy of the blast furnace he says that of the ton of coke which even good practice requires to make a ton of pig iron, but a little over 300 pounds are required for the chem-

istry of the furnace, i. e., reducing the iron; the balance is required to melt not only the reduced iron, but to form the cinder; an important portion is also consumed in the production of waste combustible gas, some of the value of which is recoverable under boilers and in the stoves for producing the blast. The 500 kw-hours in the Ruthenburg process require the combustion of 1,000 pounds of soft coal, not coke. The reduction of the ore requires 300 pounds of carbon. To explain the great saving of power in his process compared with the other processes, he points out that he does something different from the others. The others melt the ore and maintain it molten, the molten mass being a path of low resistance for the passage of the current in which reduction takes place by the hot carbon of the electrodes and the gases of carbon given off; to maintain this mass molten requires a large expenditure of energy. Instead of this he holds the ore, in only small portions at any one time, by a powerful magnet; only the portion held by the magnet is melted, the ore supply from above resting upon the magnetic bridge and being thereby restrained from slipping through. The poles of the magnetic circuit are also the poles of the melting circuit. There are no electrodes, the resistance being the ore itself, which as fast as fused is carried out of the zone of fusion and dropped, its place being taken by ore from above. Preparatory to the electric furnace, the ore should be cleaned up to the highest possible point, so as to avoid the treatment of useless earthy and cinder-forming matters. Magnetic ores may be quite lean and yet pay to crush and to clean; in some cases the crushing must be quite fine to produce economic results. This iron dust cannot be used in a blast furnace, but is just what the electric furnace wants. The ore is mixed to produce the desired chemical analysis of the finished material and the required reducing material is incorporated. At the high temperature of the electric furnace the charge is fused into a homogeneous mass, less a large part of its oxygen, and is discharged from the furnace very hot and kept hot so that the cementation may finish the elimination of the contained oxygen. The material is then ready for melting in an open hearth furnace and is steel.—*Electrochem. Ind.*, February.

Molecular Induction.—GROSS.—A description of some curious phenomena of electrolysis. In a concentrated solution of copper sulphate two copper wires are placed and are connected to a high-resistance galvanometer; when a plate of zinc is placed between them and closer to one of the wires, copper is deposited upon the zinc and a current goes from the zinc to the more distant electrode. He claims that the action is neither thermal nor due to concentration or local currents. A high e.m.f. may be obtained by immersing three zinc plates insulated on one side into the trough and connecting the two outside ones with the galvanometer. He explains it as due to a force not connected with chemical affinity, and, indeed, often opposed to it; he calls it molecular induction. He presupposes some effect of molecular vibrations.—*Ber. d. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Radiation Scale of Temperature.—LUMMER AND PRINGSHEIM.—A paper in which the authors discuss the three different methods now available for determining the temperature of a hot body by means of the radiant heat emitted by it; these three methods are expressed in the form of three different formulas, one being due to Stefan and Boltzmann, the other two to Wien. The authors point out that these laws are not merely empirical rules, but laws of Nature whose validity is as well established as the thermodynamic equations upon which thermometry is based. They prove by measurements with a hollow carbon cylinder heated to 2,300° absolute temperature, that all three methods give identical results, and that the region of accurate measurement of temperature is now extended into regions hitherto reached only by extrapolation of formulas governing thermo-electric forces.—*Ber. d. Deutsch. Phys. Ges.*, 1903, No. 1; abstracted in Lond. *Elec.*, February 6.

The same subject is discussed in an editorial note. The absolute and exact measurement of high temperatures has hitherto not gone beyond 1,150° C., that being the temperature at which the gas thermometer fails, owing to a softening or deformation of the containing vessel, whether porcelain or platinum. This recent progress is due to the work of various investigators who have raised the theory of the radiation of the "absolutely black body" into "a stately edifice of physical fact and mathematical reduction." Stefan's experimental radiation formula, which was later deduced by Boltzmann from the second law of thermodynamics, states that the total radiation from an absolutely black body—i. e., a body which absorbs all rays, whatever their wave-length—is proportional to the fourth power of the absolute temperature. To measure, therefore, any temperature, however high, it is only necessary to expose a bolometer or other radiation instrument to the black body having that temperature and measure the flux of radiant energy proceeding from it. A furnace closed on all sides, with a hole in one wall through which the radiation proceeds, behaves like an absolutely black body.—Lond. *Elec.*, February 6.

Constancy of Manganin Resistances.—LINDECK.—An account of some measurements made at the German Reichsanstalt with manganin resistances after they had been in commercial use for several years. Out of 31 resistances, consisting of sheet manganin, 15 showed variations amounting to less than 0.01 per cent. Six showed 0.02 per cent. of a secular alteration, five 0.05 per cent., three 0.1 per cent., and two more than 0.1 per cent. This shows that 26 out of the 31 resistances supplied to electrical works remained constant within the indications of the best direct-reading instruments. Among the 10 resistances showing alterations exceeding 0.02 per cent., seven were large resistances which had been used with strong currents. The two resistances whose variation exceeded the limit of accuracy marked on them (0.1 per cent.) had been used almost daily, for four years and 2½ years respectively. The former showed a decrease of 0.12 per cent., and the latter an increase of 0.23 per cent. The latter was covered with a brown mud, produced by a chemical attack of the petroleum used on the manganin. The other instrument had only turned slightly brown. The results show on the whole the admirable fitness of these resistances for industrial use.—*Zeit. f. Instrum.-Kunde*, January; abstracted in Lond. *Elec.*, February 6.

Braun Cathode Ray Tube.—WEHNELT.—A description of a Braun tube for electrostatic deflection. While the Braun tube is largely used to advantage for studying current curves by means of the electromagnetic deflection of a cathode beam, its use is very limited when it is the investigation of potential curves that is desired. He describes a Braun tube for electrostatic deflection, using internal electrodes and obtaining a permanent electrostatic deflection. His tube closely resembles the ordinary Braun tube in appearance. The curve of potential for an alternating arc shows a slight elevation at the beginning of the discharge which disappears when the discharge proceeds.—*Ber. d. Deutsch. Phys. Ges.*, No. 1, 1903; abstracted in Lond. *Elec.*, February 6.

Photometry at the British National Physical Laboratory.—GLAZEBROOK.—A communication stating that the photometric room of the (Brit.) National Physical Laboratory is now practically ready, and that this laboratory will assume the position and responsibility of a standard photometric authority, so far as this can be done without legislation.—Lond. *Elec.*, February 6.

MISCELLANEOUS.

REFERENCE.

British Westinghouse Works.—A long and fully illustrated description of these new works near Manchester.—Lond. *Elec.*, February 6.

New Books.

THE ART OF ILLUMINATION. By Louis Bell, Ph. D. New York: McGraw Publishing Company. 339 pages, 127 illustrations. Price, $2.50.

To the scientific reader Dr. Bell needs no introduction, and is no stranger, as there are few of even the most modest libraries upon whose shelves the "Electric Railway," "Electric Power Transmission" and "Power Distribution for Electric Railways," do not occupy a conspicuous position. So when one opens the covers of "Art of Illumination," it is with a hazy notion of a treatise on photometry, bristling with the law of inverse squares and redolent with symbols. But it is nothing of the kind. The mathematician will turn its leaves in vain, for in its three hundred odd pages there are not a half a dozen formulæ, and *x's* and *y's* are conspicuous by their absence. Here and there a table appears, but is so successfully interwoven with the text that the reader absorbs it unconsciously. Ruskin says that "art is nature viewed through temperament," and this is the case with "Art of Illumination," for the subject is largely viewed from the art side and not from the math-

ematic. It is illuminated as it appeals to the senses, and not the abstract laws of light that are discussed. Furthermore, it teaches how to make illumination attractive, comfortable and seductive, rather than an exhibition of the why-thereof. But the science of illumination is by no means neglected, for in all the methods advocated Dr. Bell clearly shows a scientific basis for the principles elucidated.

At the outset, in Chapter I, the author discusses the relation of light to the sensation of vision, showing why, under some circumstances, there is a gratifying comfort in working or reading, and in others an acute discomfort. In Chapters II and III the principles of color and reflection and diffusion are taken up, and some curious facts illustrated as to the proper methods to be adopted in using colored light. The effect of reflection and diffusion in modifying the color of illumination, is strongly presented. The next four chapters deal with the materials of illumination, and are descriptive of the illumination now available in common practice. Candles and kerosene are given but little more than a brief mention, probably because the author appears to feel that the "Art of Illumination" deserves better materials. To the various uses of gas, particularly the incandescent mantel, forms of re-generative burner, and the employment of acetylene, much space and particular attention is given. The next chapter deals with the incandescent electric lamp, particularly with the newer types of the Nernst variety. In the last few pages of this chapter there are some valuable observations as to the direction of probable improvement, and an interesting analysis of fire-fly light.

Chapter VII is occupied with the electric arc in its various forms of open and enclosed, direct and alternating current; instructive comparisons being drawn as to the usefulness of the various types. Chapter VIII, upon shades and reflectors, is really a continuation of the preceding chapters, dealing with the electric lamp under the modified conditions that are imposed by the various form of shades and reflectors that art and science have contrived.

But upon Chapters IX, X and XI, treating of domestic illumination, the lighting of large interiors and street and exterior illumination, the attention of the reader is most sharply focused, for these chapters contain the real gist of the book. There is literature galore upon the arc and incandescent, but one may search through many libraries without finding a hint as to how to use lights in a manner to produce pleasing and satisfactory results, and withal with the greatest economy. In these three chapters Dr. Bell reads many an architect a most useful lesson, and one which it is hoped will be received with the attention it deserves.

Chapter XII deals with decorative and scenic illumination, probably from a sense of desirable completeness, for while all will admit the magnificence of the illumination of the Pan-American few would even view that spectacle with the same interest as would be excited by the comfort of an after-dinner easy chair and the evening paper, in a tastefully and artistically-illuminated interior.

In Chapter XIII the author indulges in some prophecies as to the illumination of the future, and tersely sums up the matter by stating: "Illumination is not a science with well-defined canons, which might be termed illuminating engineering, but an *art* wherein an indefinable and uncommunicable skill pertains, almost as it does in the magic of the painter." In this sentence Dr. Bell strikes the keynote of the work, and proceeds to show that improvement is far more likely to develop from the exercise of such skill than from the possible utilization of fire-fly light or new form of vacuum tube, although either of these is entirely within the range of conceivability. In the last chapter a résume of standards of light and photometry is given.

In scientific literature the "Art of Illumination" is a distinct departure from the typical treatise with its numbers and its formulæ. It is art and not science, and in it art is no less displayed in the style of the author, which so charms the reader, as to cause him to forget the treatise in the interest which it excites.

THE HOW AND WHY OF ELECTRICITY. By Charles Tripler Child. A Book of Information for Non-Technical Readers. New York City: Electrical Review Publishing Company, 1902. Olive green Cloth, 6 in. x 7¾ in. (13.5 x 19.5 cms); 127 pages 40 illustrations. Price, $1.00.

This is a charmingly written and interesting little book, not merely to the uninformed, owing to its simplicity, but also to the informed, owing to the precision of its statements and the clearness of its style. A wide range of practical subjects is covered in twenty-three chapters. Elementary information in all these subjects is conveyed in such a manner that an untechnical reader can readily grasp the meaning and at the same time the story of each subject is so entertainingly told that the reader is brought to understand the most recent development in that subject without losing interest or wearying of the study.

The book will commend itself to elementary students of electrotechnics, and to the great mass of the intelligent public interested in the developments and applications of electricity.

ELECTRICITY AND ITS SIMILITUDES: The Analogy of Phenomena, Natural and Spiritual. By Charles H. Tyndall, Ph. D., S. T. D. London and Edinburgh: Fleming H. Revell Co. 215 pages, 10 plates. Red Cloth, 5 in. x 8 in. (13 x 20 cm). 1902. Price, $1.00.

This is a very interesting book psychologically. The author is clearly an educated man and a good writer of English. He appears to be an earnest and honest writer deeply imbued with religious spirit; but he has adopted a method of mixing religion and science in a manner that to many scientists brings religion into ridicule. The religious thoughts suggested by the book we do not in any way desire to criticise or find fault with. That subject is, of course, in itself a sacred topic; but to write a book in which Scripture verses alternate with scientific propositions is to sail dangerously close to the farcical. Moreover, the tendency is promoted to make loose and inaccurate scientific statement. There are numerous accurate scientific statements in the pages under consideration, but there are also many very loose, inaccurate statements.

Wonderful analogies are presented to our minds by this book. Thus the Branly coherer in its normal condition of electric resistance is likened to the condition of the wicked soul in its normal sinful resistance to truth. The phenomenon of electric coherence is thus paraphrased: "Invisible energy from Heaven's battery has come into contact with the soul; disorder has vanished; spiritual continuity with God is established, and resistance has given place to conductivity of the tenderest sort, and it is one which also persists."

The last statement seems to call for "God save the King" at the end, as a fitting peroration. But in a certain sense it is immoral to inculcate such doctrines in a book that pretends to be quasi-scientific. The analogies are necessarily quite inapplicable to the real phenomenon in nature thus paraphrased. The wrong idea is given to the student's mind and the result is false teaching, which is worse than none.

We recommend the book to those versed in electricity and possessed of a sense of humor.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS, Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE, Secretary, Wm. J. Davis, Ithaca, N. Y.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS, Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., September, 1903.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

High Power Horizontal Gas Engines.

The Westinghouse Machine Company has for some time been engaged in developing the double-acting gas engine, and is now prepared to build this type, for powers ranging as high as 3,000 hp. As this type of engine possesses features somewhat novel to those accustomed to the usual reciprocating engine design, a brief description may be of interest.

Fig. 1 shows a perspective view of a single-crank engine of the new type and Fig. 2 that of a double-crank engine. Fig. 3 shows the general design of a single-crank engine direct connected to an electrical generator.

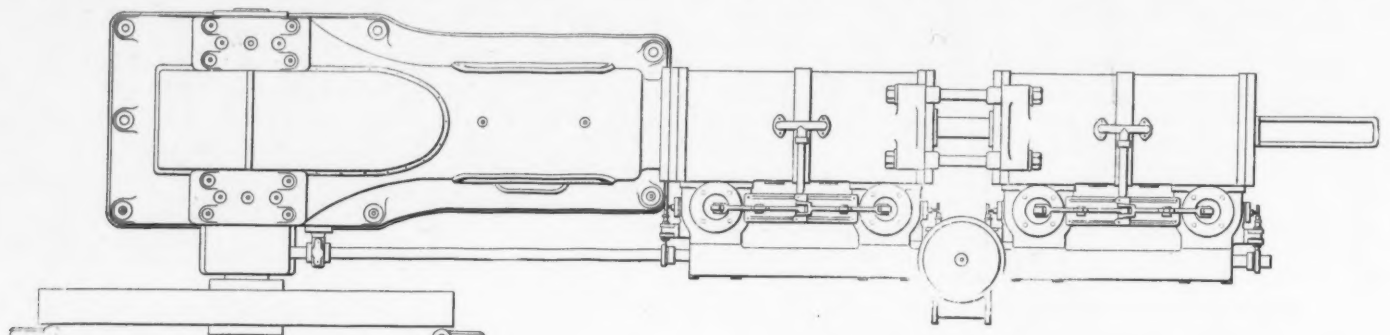


FIG. 1.—PLAN VIEW OF SINGLE CRANK GAS ENGINE.

It is quite apparent from the accompanying views that the general design of the engine resembles to a noticeable extent that of a modern high-speed tandem compound steam engine in the arrangement of cylinders, frames, bed plates, bearings, flywheel and generator. This resemblance is further carried out in the matter of crank effort. Each revolution is accompanied by two impulses, one occurring at each successive in-stroke and out-stroke. The engine operates, therefore, upon the four-stroke cycle, involving distinct periods of admission, compression, explosion, expansion and exhaust; this cycle yielding the highest practical as well as theoretical thermal efficiency and economy of fuel.

In direct distinction from the use of an explosive mixture varying in richness according to the load, the Westinghouse design employs a mixture of unvarying quality, which is initially proportioned according to the nature of gas used, but which remains constant under all conditions of load. As the load upon the engine increases or decreases, a corresponding greater or lesser quantity of mixture is admitted to the cylinders, thus utilizing at all times an explosive mixture of strength, resulting in higher thermal efficiency and economy of fuel. That this method is productive of the best results in engines of high power is apparent from the fact that reputable European builders such as the Deutz, Cockerill and Nurnberg companies, are abandoning the variable for the constant mixture method of governing.

The construction of the engine under description is in many respects unique, in that it departs materially from the accepted European design and embodies many established features of modern steam engine practice, which have been so instrumental in bringing about the success of the well-known Westinghouse vertical single-acting type. From crank to cylinders, the construction is that of a horizontal steam engine suitably strengthened in proportion to the increased maximum pressure resulting from the rapid combustion of the highly compressed gases. The design of cylinders, pistons and valves, of course, departs materially from steam engine practice. The cylinders are double-walled, with the outer walls split peripherally to permit independent expansion and contraction without placing the cylinder casting under stress. The two cylinders are united at the top by heavy tie rods, engaging peripheral bosses, and at the bottom by a stout cast-iron distance piece. The rear section of the bed plate which supports the two cylinders is cored hollow with a central dividing wall, and serves as a reservoir for incoming and outgoing circulating water. All connections are piped directly to these reservoirs, thus avoiding a large amount of piping about the engine. Through the bed plate extend the four vertical exhaust pipes, which connect immediately below with an exhaust main. The exhaust passages leading from the valve chambers are cast integral with the cylinders, upon their under sides, and are water cooled.

At the ends of each cylinder occur horizontal side ports, resembling straight steam ports, which communicate with removable combustion chambers. The cylinders are closed by water-jacketed heads, those located between the two cylinders being split diametrically for facility in inspection of the interior, and the two halves are united with a ground fit, no packing being found necessary. This feature obviates the necessity for completely dismantling the engine for inspection.

The location of valves and combustion chambers in the new design is especially fortunate, and the contrast between the simplicity of this arrangement and the formidable complexity of numerous European types is striking. The arrangement shown in the accompanying illustrations accomplishes the same purpose at far less cost and with less complexity. The combustion chambers are independent castings, with plain machined faces, circular valve-liner seats, and cored-out passages for circulating water. Both admission and exhaust valves, which are of the standard poppet type, operate vertically and with opposite throw. They open by cam movement and are held to their seats by spring pressure. The central space, closed by the admission valve above, and the exhaust valve below, communicates directly with the cylinder port before mentioned; the exhaust space with the exhaust passages on the under sides of the cylinders; the admission space with the supply pipe. This supply pipe is a rectangular cast-iron main extending along the entire front and provided with openings opposite each admission valve. It receives its supply from the governor chamber located midway between the two ends, this in turn communicating with a mixing chamber supplied on the one hand with gas and on the other with air through suitable valves.

These two valves are shown in Fig. 1, and are provided with graduated indices, so that the exact proportions of gas and air may at all times be visible, and under the control of the attendant. Another feature of the greatest importance is found in the provision for interchangeable parts. Each valve, together with its spindle and seating spring, is independently mounted, and by simply removing the

bolts from the bonnet the entire valve, seat and liner may be drawn out for inspection or replacement by a spare. Similarly the igniters, which are of the "make-and-break" electrical contact type, employed in all Westinghouse engines, are mounted in a removable plug extending into the combustion chamber through the side walls.

The valve gear is of the standard cam and roller pattern, also employed in the Westinghouse vertical engines, and is driven by a helical gear, engaging a similar split gear bolted around the main shaft.

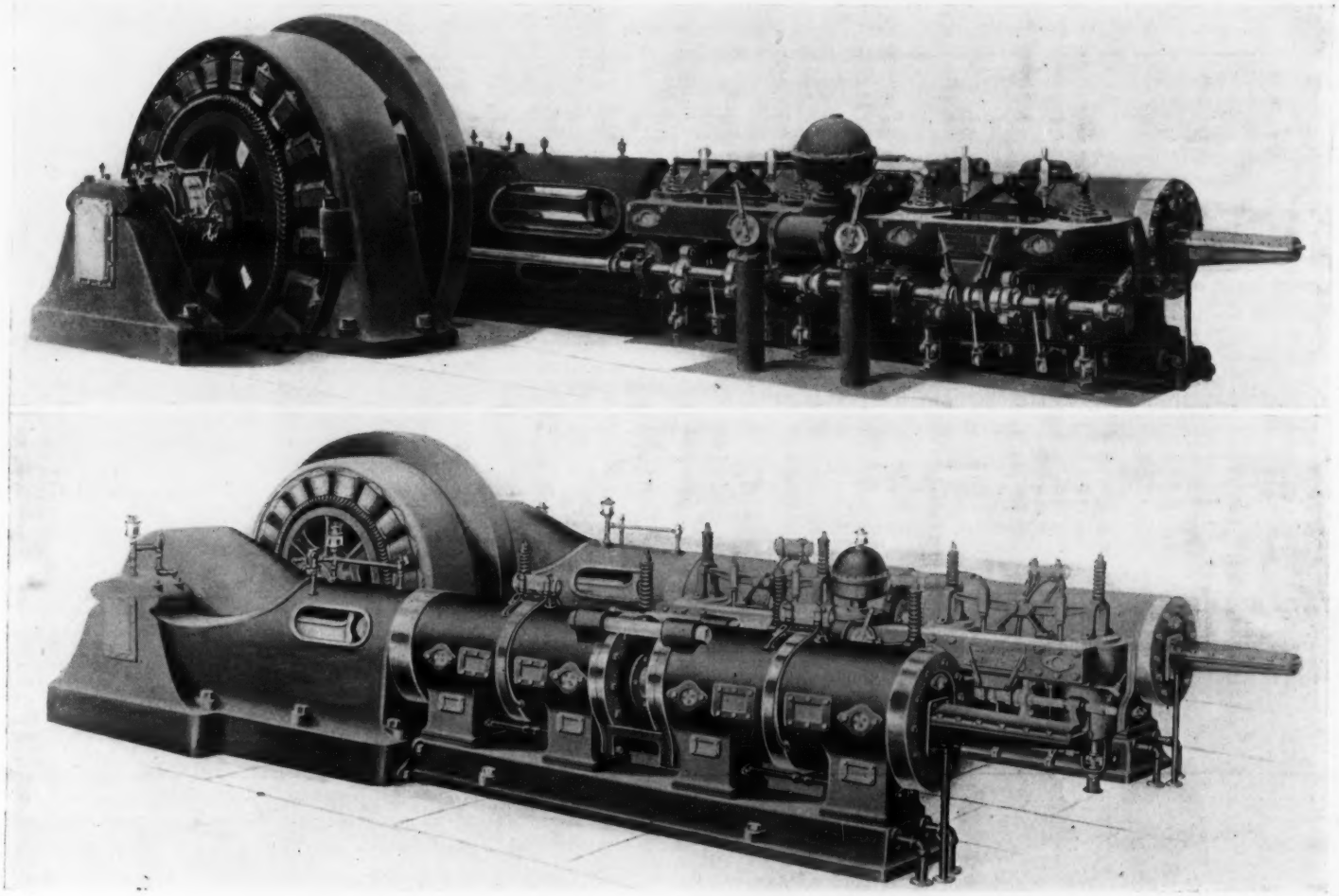
The method of circulating cooling water through the pistons is unique. This water enters a cavity on the cross-head by means of a flexible pipe connection provided with special swinging joints. It then flows through the hollow piston rod to the front and rear pistons, through which it circulates, finally emerging through a bronze tail rod extending through the rear head, there emptying into a cast-iron jacket communicating with the hot water return pipe. Similarly, cold water is conducted through suitable pipes to the cylinder jackets, thence to the jackets surrounding the exhaust valves and ports, and finally to the return pipe, emerging at a sufficiently high temperature for use in heating and drying coils, radiators, etc. By the above method the proper temperature relations between pistons and cylinders is at all times secured, thus allowing close piston fits to be employed without danger of excessive friction or rupture. This point may be more readily appreciated from the fact that a cold piston clearance of approximately 1/16 in. is necessary in moderate-sized engines not fitted with water-cooled pistons. The pistons are constructed in two parts, with packing rings and babbitted bearing surfaces. They are secured in position on the rods by internal nuts and present plain convex surfaces to the burning gases. Piston rods are of forged steel, with bored water ducts. The packing for both piston rod and tail rod is of metallic ring type.

The engine is started by compressed air pumped into a steel reservoir during a previous run before shutting down. For this purpose a special disengaging gear is provided which isolates the rear cylinder and on admitting the compressed air, allows this cylinder to operate as an air motor until the regular combustion cycle is taken up in the forward cylinder. The rear cylinder may then be thrown into normal action. Oiling is accomplished by steam engine appliances, such as sight feed cups, cylinder pumps and oil rings for crank pins.

The engine is governed by a sensitive flyball governor of the standard design, protected by a circular housing. It operates a vertical piston valve supplying a fuel mixture of constant quality, but in quantities proportionate to the load.

The single-crank engine is at present manufactured in sizes ranging from 250 to 750 hp, and the double-crank from 750 to 1,500 hp. In the latter cranks are placed at 90° angularity, giving four impulses per revolution, and a crank effort corresponding to that of a cross-compound, double-acting steam engine.

It is of interest to note that several installations of this type of engine are in progress. The first to be put into operation will be at the works of the Consolidated Industries Company, Batavia, N. Y., employing 250 hp, single-crank, double-acting engines, direct connected to Westinghouse alternating-current generators, operating in parallel upon a general light and power distribution system. A special coke and gas process known as the Lowe will be employed, yielding three products, metallurgical coke, coal and water gas, the former to be retailed and the latter used for power purposes.



FIGS. 2 AND 3.—VIEWS OF SINGLE-CRANK AND DOUBLE-CRANK GAS ENGINES.

A second installation at the works of the Atlantic Refining Company, Philadelphia, the engines are double-crank, double-acting, of 500 hp each, and are direct connected to Westinghouse 350-kw, three-phase generators, arranged for parallel operation. The engines will operate upon rich oil gas of approximately 1,400 B.t.u. per cubic foot, a by-product of the refining process.

A third interesting installation at Hillburn, N. Y., will supply the entire Ramapo Valley with light and power from a new station now building for the Rockland Electric Company. This plant will also operate upon producer gas, using the Loomis-Pettibone process. The producer plant is located in a separate building and supplies water gas to the Ramapo Iron Works and the Ramapo Foundry Company for heating and metallurgical purposes, as well as power gas to the generating station. The electrical distributing system will supply power to local industries, as well as lighting for the Ramapo Valley, some fourteen miles in extent. The equipment aggregates 1,200 hp, employing 350-hp single-crank engines of the double-acting type, and a small vertical single-acting engine for

driving the exciter. Each main engine is direct connected to Westinghouse polyphase generators, arranged for parallel operation. This plant will be one of the first alternating-current stations in the country to be operated from gas power.

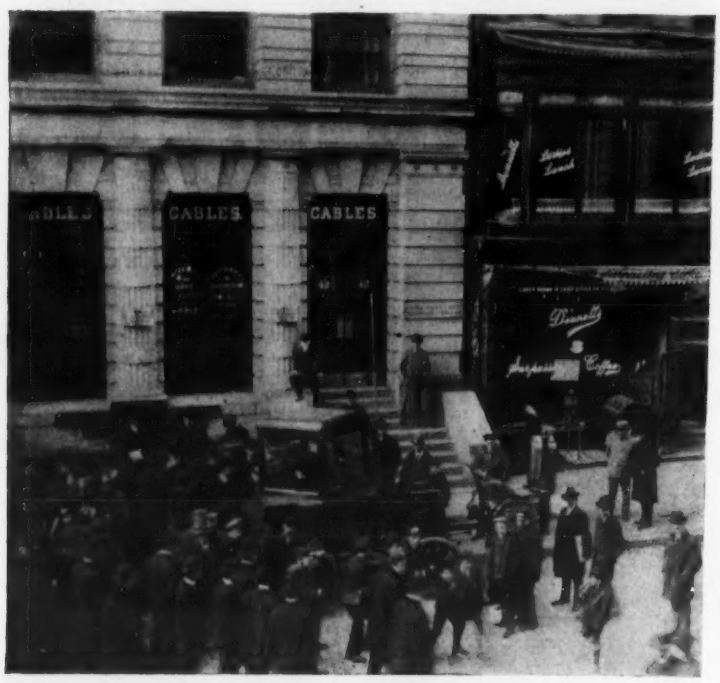
A further and more recent instance of the confidence placed in the gas power apparatus is that of the Potosina Electric Company, of San Luis Potosina, Mexico, a town of 70,000 inhabitants, situated at an elevation of 6,000 ft. above sea level, about 275 miles northwest of Mexico City. The town was formerly supplied with electric light and power from a direct-current steam-driven plant, which passed into the control of the present company, and has been converted into a gas central station.

The plant has been laid out for five main units, an exciter unit and a compressor, aggregating 1,225 hp, and will employ the Loomis-Pettibone process for generating a power gas of approximately 120 B.T.U. per cubic foot, calorific value. At the present time but five engines will be installed, comprising three 160-hp, single-crank, double-acting machines, direct connected to Westinghouse polyphase generators, operating in parallel upon the general 2,200-volt, three-phase distributing system; one 50-hp, two-cylinder, vertical single-acting, direct connected to an exciter, and one 14-hp, two-cylinder vertical compressor engine. The remaining units, each of 340 hp, will be installed later, when required. The producers will be located in a separate gas house and the best grades of Virginia coals will be used for gasification purposes.

The four installations above noted are among the first applications of fuel gas to power purposes, and the advent of the modern high-power gas engine should serve to open up an entirely new field in gas engineering. A number of power gas processes are now available, including the Loomis-Pettibone, Taylor, Mond, Otto, Hoffman, Lowe, Dellwick, Fleischer and Dowson, and the results obtained from installations now in service give every reason to believe that the gas power will be shortly much in evidence.

A Perambulating Wireless Telegraph Plant.

One of the most ingenious and interesting innovations seen lately in the wireless telegraph field is the introduction of a perambulating plant by the American De Forest Wireless Telegraph Company, ostensibly for stock reporting purposes, though it serves equally well to advertise the company itself as an investment, to the enterprising financiers of the Wall Street district. On February 7 a decided sensation was made on the "curb" by the appearance of an electric automobile of special design bearing on one side the legend, American De Forest Wireless Telegraph Co. On another side was the statement, "Aerograms Received," and on still another side, "Approved and Adopted by the United States Government." The vehicle is surmounted by a glass showcase cupola about three feet square, and in front is a brass pole about twenty feet high, which serves in place of the usual antennæ wires. The operator sits inside the glass box, seen and seeing, so that all his operations can be watched by the "man in the street." Great interest was manifested in the novel machine, when it took up its position among the curb brokers and began to send the market reports into the offices of the *Wall Street Journal* and the nearby brokers.



WIRELESS TELEGRAPH PLANT.

In equipping this automobile outfit it was not possible to use the full De Forest system as that would require a motor generator, and high-voltage transformer, which there was not sufficient space to accommodate; therefore, recourse was had to an induction coil giving a two-inch spark actuated by the storage battery furnishing power for the propulsion of the auto. The De Forest Company states that De Forest responders were placed in offices up and down Broad Street and successful aerograms giving the latest market reports were furnished to all simultaneously. It is understood that the company have a number of similar machines in course of construction and will rent them for the reporting of athletic events, and for the use of any one who wishes to leave the city and still keep in touch with his house or business.

Electrical Gold Dredges in the Klondike.

The Western Engineering & Construction Company, of San Francisco, is about to instal, in the territory south of the Yukon district, a power transmission plant for the operation of a gold dredge which will be erected at Atlin, B. C., two miles distant from the power plant. This is a new development in the methods of mining in this region, which is a very important placer district, and much gold that would otherwise be lost will be saved by the use of electrically-operated dredges. The work to be done here is similar to that carried on at Oroville, Cal., although the gold is coarser in the Atlin District, being found in nuggets from the size of a pinhead to that of an ostrich egg.

The electrical equipment for this plant consists of the following apparatus, recently purchased from the Westinghouse Electric & Manufacturing Company: Two 180-kw belted alternators, which are to be driven by water wheels; two variable-speed induction motors with controllers; two standard induction motors for driving the pump, one of 20 hp and the other of 50 hp; and a 15-hp motor for operating screens.

It is expected that the machinery will be in operation in July of this year, and enough gold recovered during the season to pay the entire cost of the installation, which, including the hydraulic machinery, amounts to over $150,000. A gold dredge costs from $40,000 to $75,000, depending upon its capacity, and consists of the dredging machine proper and the pumping apparatus which supplies the necessary water for washing and sluicing. The dredge machinery comprises a chain of electrically-driven buckets which pick up the material, a steel hopper into which the material is emptied, a revolving screen designed to receive and wash the excavated material, an appliance for carrying off all the coarse tailings and stones that are rejected by the screens, a sluice box in which the water and fine material containing the gold are disposed of and in which the gold is saved. The stone chute is of a sufficient height and inclination to discharge the material clear of one side of the boat, so that no obstruction can take place on account of the accumulation of tailings. From the under side of the screen all the fine material,

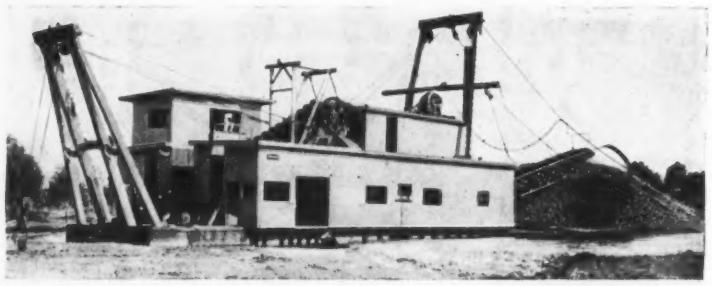


FIG. I.—ELECTRIC GOLD DREDGE.

including the gold, is discharged with a considerable quantity of water—all of which is carried off and over the stem of the dredge through a sluice box containing a series of riffles in which the gold is caught, and of a length sufficient to carry the tailings clear of the dredge and to save all the gold. When the gold is of too fine a character to be efficiently collected in the ordinary sluice box, a finer screen and gold saving tables are employed.

Formerly the dredging apparatus and pumps were operated by

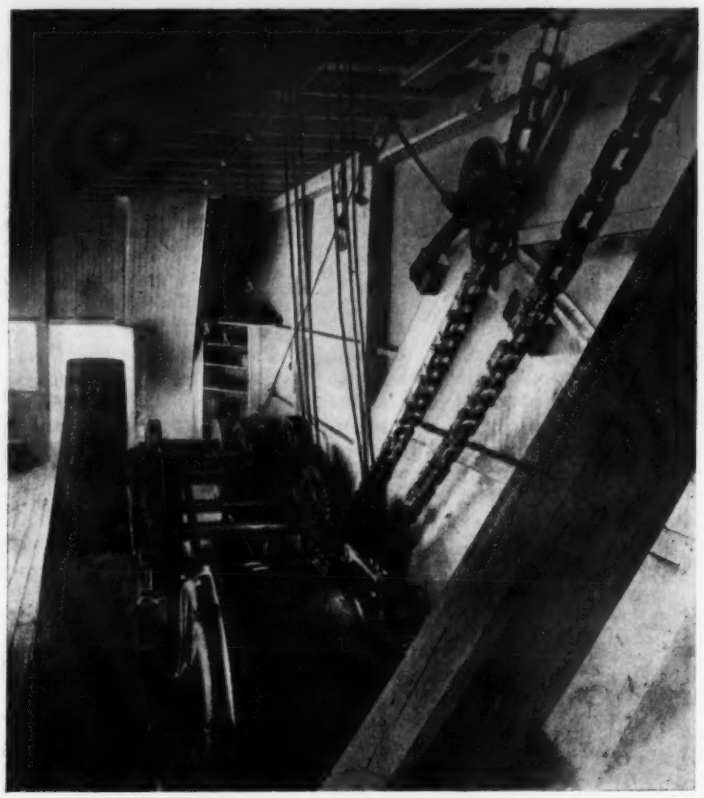


FIG. 2.—DETAILS OF DREDGE.

steam engines, and this practice is still largely continued. Electric power, however, is preferable, since it admits of the operation of dredges where fuel is difficult to obtain, the lighting of the dredge by electricity and, if necessary, the carrying on of the work at night. An electrically-operated dredge is illustrated in Fig. 1, showing at the left groups of incandescent lamps mounted in reflectors. Fig. 2 is an interior view of a dredge, showing a variable-speed, Westinghouse induction motor driving a countershaft from which the main dredging buckets are operated.

St. Louis Fair Boiler Plant.

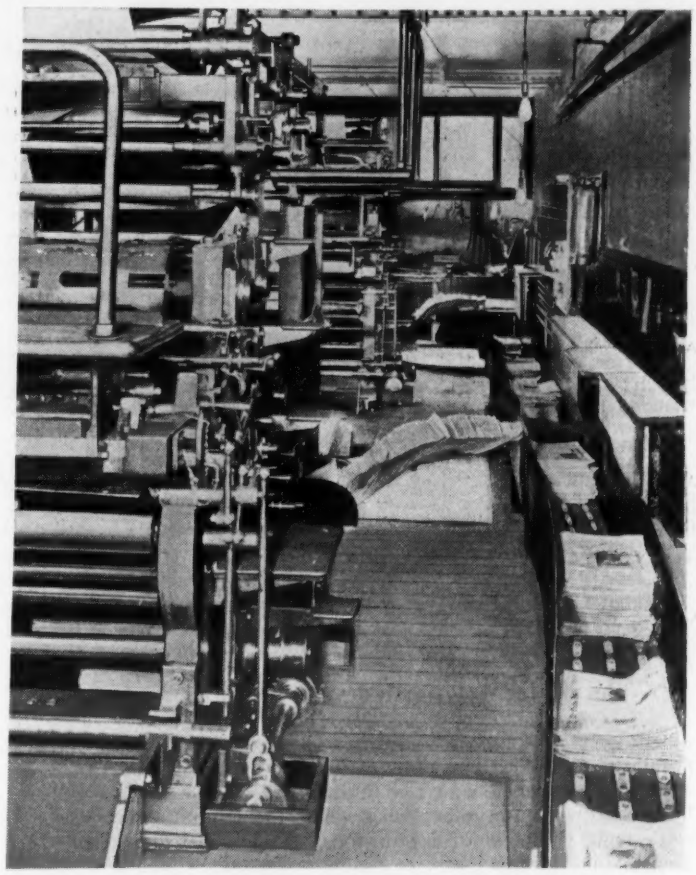
Williams & Wollender signed a contract on February 7 for the erection of a temporary boiler house on the site of the permanent boiler house just west of the Machinery Building, St. Louis Exposition. The temporary boiler house will be built of corrugated iron and wood, of such size that the permanent boiler house can be erected around it and so that it may be wrecked and removed after the permanent house is finished. Here will be installed boilers, engines and generators which will make the light for the dedication ceremonies, for the Saengerfest and for the International Press Congress following. The erection of the temporary house was made necessary by the impossibility of erecting in time for the dedication ceremonies the permanent boiler house and its operating appurtenances. It was found impossibile also to secure from the street railway companies sufficient current for lighting the grounds, and it was learned that the outside contractor, who will supply a part of the vast amount of current needed, would not be ready in time to furnish the light for the dedication. The temporary boiler house will cost considerably less than $2,000, but will house securely machinery capable of producing about a thousand horse-power. Its dimensions will be 66½ by 36 ft. It will contain the Duerr marine boiler recently received from Germany, and two boilers from the Clonbrook Boiler Company, of Brooklyn, N. Y., with ratings, respectively, of 350 and 300 hp. The engine room will contain one engine of 150 kw. capacity from the Skinner Engine Company, and another of the same capacity from the Buffalo Forge Company.

Handling Newspapers by Motor Driven Conveyor.

A recent installation in the office of the *Philadelphia Bulletin* is of novelty and interest. It is the application of the link-belt conveyor to handling newspapers in the press room.

In several features this carrier is unique. There are three parallel roller chains, of special design, running on edge. The conveyor trough is of sheet iron and of sufficient depth to carry piles of 200 papers safely. The action of the carrier is steady and practically noiseless. Its trough occupies scarcely 2 ft in width and it winds in a tortuous course around various obstructions in the most amazing fashion, always with the same easy movement of well-oiled regularity. Mr. Loveland, chief engineer of the *Evening Bulletin*, has supplied an auxiliary carrier from the fly box of each press to the side of the main carrier. It consists of two parallel Ewart chains which convey the papers from the fly box to a shelf alongside the trough of the conveyor. The fly boy is thus able to stand upright and to easily lift the papers, in counted bundles of 50, to the chains of the carrier. The movement of this auxiliary carrier is so timed that the ink dries sufficiently in transit to prevent smudging of the papers in handling.

There are seven large quadruple presses in the *Bulletin* press room, each rattling off finished 16-page papers at the rate of 24,000 per hour, or 8-page papers at the rate of 48,000 per hour. Before the introduction of the link-belt carrier 14 men with 14 trucks were kept busy carrying these papers from the fly boxes to the circulation department. The carrier does away with all these men, their confusion and wages, and does the work better, quicker and with unvarying



VIEW OF PRESS ROOM SHOWING NEWSPAPER CONVEYOR.

efficiency. Mr. McLean states that if the carrier did not save a penny in wages, it would still be a good investment, because it dispenses with the maddening confusion of 14 healthy men rushing to and fro with their 14 trucks in the none too ample avenues between the rapidly-moving presses. The Link-Belt Engineering Company, Nicetown, Philadelphia, devised and installed this conveyor, which is driven by a 7½-hp Storey electric motor, connected to the drive shaft by Renold silent chain.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money was in good demand and business of considerable size was transacted, closing at 5 per cent. for 60 to 90 days, 4½ per cent. for 4, 5 and 6 months. The stock market was irregular and rather heavy, with trading in the hands of professionals. Various unfavorable rumors of rather indefinite character, aimed apparently at Metropolitan Street Railway, circulated throughout the week, but as such have been common of late the latest had little apparent effect upon the market. The approaching holiday also had an apathetic effect on trading. Amalgamated Copper was strong, but afterwards reacted. Metropolitan was vigorously attacked by bear operators and weakened the other transactions, but Friday's market showed a tendency to recover all around. Brooklyn Rapid Transit made a net gain of ¼ point, closing at 69½, after having touched 71⅛, the sales aggregating 76,745 shares. Metropolitan Street Railway reached 140½ and closed at 139¾, being a net gain of 1¾ point on sales of 63,730 shares. The electrics exhibited general weakness, all closing with losses as compared with the last previous quotations. After having mounted to 204 General Electric closed at 199⅝, which was ⅝ above the lowest quotation of the week. The net loss on the week's trading was 2¾ points. Westinghouse common suffered a decline of 7 points, closing at 211, the highest figure of the week being 217. Western Union receded fractionally, closing at 89⅝, which represents a net loss of ⅜ point. American Telegraph & Telephone was the exception, making a net gain of 5⅜ points, the closing quotation being 168½, only 200 shares having changed hands. American District Telegraph receded 1½ points, closing at 37. Commercial Cable kept steady at 161 throughout the week, this figure being 4 points lower than the last quotation. Following are the closing quotations of February 24:

NEW YORK.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 24
American Tel. & Cable	84	83¾	General Electric	200	198
American Tel. & Tel.	165	167	Hudson River Tel.	..	..
American Dist. Tel	37	37½	Metropolitan St. Ry.	139½	137¼
Brooklyn Rapid Transit	70¼	68⅞	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	20	N. Y. E. V. T. Co.	10	10
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	3	3	Western Union Tel.	90	89½
Electric Vehicle	6½	6	Westinghouse com.	217*	212
Electric Vehicle pfd.	11¼	11	Westinghouse pfd.	220*	210

BOSTON.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 2
American Tel. & Tel	166½	167½	Western Tel. & Tel. pfd.	..	99½
Cumberland Telephone	..	125	Mexican Telephone	2¼	2¼
Edison Elec. Illum.	305	..	New England Telephone	..	137
General Electric	200¼	190	Westinghouse	104	105
Western Tel. & Tel	25¼	25	Westinghouse pfd.	105	105

PHILADELPHIA.

	Election Day.	Feb. 24		Election Day.	Feb. 24
American Railways		52	Phila. Traction		98¼
Elec. Storage Battery		..	Phila. Electric		7⅞
Elec. Storage Battery pfd.		..	Pa. Electric Vehicle		..
Elec. Co. of America.		9⅛	Pa. Electric Vehicle pfd		3

CHICAGO.

	Feb. 17.	Feb. 24		Feb. 17.	Feb. 24
Central Union Tel	..	..	National Carbon pfd.	98	98
Chicago Edison	162	..	Northwest Elev. com.	..	..
Chicago City Ry.	220	222	Union Traction	10	10
Chicago Tel. Co	157	158	Union Traction pfd.	45	44
National Carbon	25	25			

*Asked.

BOSTON EDISON EXTENSION.—The Edison Electric Illuminating Company, of Boston, has awarded a contract for the building of the first two units of its South Boston plant to Whidden & Co., of Boston. The two units will be of 10,000 kw capacity. The South Boston plant will contain five units eventually, and aside from the plant of the Edison Company in Chicago will be the largest in the world and capable of supplying light and power to all of the companies within a radius of 20 miles from Boston. The Edison Company acquired recently the Dedham, Blue Hill, Milton, Natick and Framingham Electric Light Companies, and aside from this a number of gentlemen, among whom is President Edgar, of the Edison Company, have bought the Somerville, Woburn and the Newton & Watertown. The latter companies were not bought directly for the Edison Company, but merely as an investment, and for the present at least will be operated independently of the parent company. It is probable, however, that within a short time practically all of the companies in and around the city of Boston, with the exception of the Cambridge Company, will be acquired by the Edison Company. A petition to the gas commissioners for authority to issue new stock to pay for the companies acquired will be presented shortly.

UNION SWITCH & SIGNAL.—The financial statement of the Union Switch & Signal Company for the year ending December 31, 1902, follows:

Earnings:	1902.	1901.		Changes.
Sales	$1,772,385	$1,604,009	Inc.	$168,376
Interest	1,620	1,639	Dec.	19
Total	$1,774,005	$1,605,648	Inc.	$168,357
Total disb., includ. int. on bonds..	1,420,321	1,308,142	Inc.	112,179
Total	$353,684	$297,506	Inc.	$56,178

As already noted, Col. H. G. Prout has become associated with this concern, and has just been elected first vice-president and general manager.

WESTERN ELECTRIC STOCK DIVIDEND.—The directors of the Western Electric Company have voted to issue a stock dividend of $2,000,000, or 20 per cent. This will increase outstanding stock to $12,000,000. The dividend is payable March 10 in certificates of $100 each, no fractional shares to be issued. All fractions are to be aggregated and sold by the company's officials at the best obtainable price, the proceeds to be divided among the persons entitled thereto pro rata. Stock certificates are to be issued and mailed on March 10 or as soon thereafter as possible. The stock of the Western Electric Company sells on the Chicago curb at around 280 to 300 and very little of the stock is understood to come out on the market, it being very strongly held.

NATIONAL CARBON REPORT.—The annual report of the National Carbon Company shows that the company's assets February 1, 1903, amounted to $10,324,028.88, of which $9,270,000 was in real estate, plants, machinery, etc.; $448,215.57 in merchandise, manufactured and unmanufactured and $364,601.51 in bills and accounts receivable. The liabilities include: Preferred stock, $4,500,000; common stock, $5,500,000; accounts payable, $89,278.01, and profit and loss, $156,000.87. The net earnings of the company for the fiscal year ended January 21 were $594,371.76.

LAKE SHORE ELECTRIC.—The stockholders of the Lake Shore Electric Railway, extending from Cleveland to Toledo, have ratified plans of the directors for issuing a total of $11,000,000 in bonds and $1,500,000 in new preferred stock. Only $5,000,000 of the bonds will be issued immediately, and the new preferred stock will be offered to the old stockholders at 60. The receiver will probably be relieved within 60 days. At least $500,000 will be devoted to betterments of the property.

EVERETT-MOORE SECURITIES COMPANY.—It is reported that Mr. Henry A. Everett, E. W. Moore and other associates contemplate the organization in Cleveland of a securities company with a capitalization of about $50,000,000 for the purpose of taking over, under a lease, the Detroit United Railway, the Toledo Railway & Light Company, the Cleveland, Painesville & Eastern, the Lake Shore Electric Railway and probably the Northern Ohio Traction Company.

NEW BONDS LISTED.—The New York Stock Exchange has listed the following securities: New York Gas & Electric Light, Heat & Power Company's $3,500,000 first mortgage, collateral trust, 5 per cent. bonds, making the total amount listed $15,000,000, and Western Union Telegraph Company's $1,000,000 4½ per cent. funding and real estate mortgage 50-year bonds, making the total amount listed $14,000,000.

AMERICAN RAILWAYS.—The management has under consideration the taking over of a new property which will involve the expenditure of about $100,000. The concern referred to, as a result of bad management, is to-day practically in the hands of its bondholders. If this deal goes through, $100,000 will have to be put practically all on the plant, which is in very bad condition.

MARCONI WIRELESS.—The Marconi Wireless Telegraph Company of America, it is stated, may issue new treasury stock in order to raise $250,000 to complete construction work now needed for regular commercial operation.

NEBRASKA TELEPHONE.—Dispatches from Omaha state that the Nebraska Telephone Company has increased its capital from $1,800,000 to $2,400,000, to pay for extensions and improvements.

GENERAL ELECTRIC STOCK.—Application has been made to the New York Stock Exchange to list General Electric Company $1,973,000 additional common capital stock.

TWIN CITY RAPID TRANSIT.—The annual report shows that Twin City earned 7.06 per cent. on its common stock in 1902, the gross being $3,612,211 and the net $1,982,042. The total of revenue passengers carried were 71,830,971, against 63,009,957 last year. There are 252.55 miles of track in the entire system and President Thomas Lowry says that the physical condition of the property is better than ever before. The company has sold $1,501,000 of its common stock to its stockholders at par. The proceeds of the sale were used partly for improvements during the past year and the remainder is held for the same purpose in the future. There was expended during the year the sum of $1,330,683 for power plants, cars and new construction. The first of last May the company cancelled $20,000 of the remaining $250,000 7 per cent. 1st mortgage bonds of the Minneapolis Street Railway Company, redeeming them in cash.

AMERICAN GRAPHOPHONE COMPANY.—The American Graphophone Company reports for the year ended September 30, 1902, total earnings of $276,778, from which was deducted for dividends, etc., $132,490, leaving a surplus of $144,287. Surplus October 1, 1901, was $186,528, thus making the total surplus October 1, 1902, $330,815. The general balance sheet as of September 30, 1902, follows: Assets—Patents, franchises, etc., $1,270,280; stock, not issued, $144; plants, $744,249; raw material, $78,153; goods in process of manufacture, $164,382; goods on hand, $138,447; accounts and bills receivable, $274,721; cash, $66,847; stock and bonds, $68,818; total, $3,216,652. Liabilities—Preferred stock, $800,000; common stock, $1,200,000; mortgage, $100,000; debenture 5s, due 1918, $451,500; accrued interest and taxes, $308,990; balance due Burt Company, $15,000; depreciation, etc., $10,347; surplus, $330,815; total, $3,216,652.

ST. JOSEPH TRACTION DEAL.—Redmond, Kerr & Co., of New York and Chicago, and Graham, Kerr & Co., of Philadelphia, are offering at 102½ and accrued interest St. Joseph Railway, Light, Heat and Power Company first mortgage 5 per cent. thirty-five year gold bonds. In a letter from the President of the company to the bankers, it is stated that the company has acquired the St. Joseph Traction & Lighting Company, People's Railway, Light & Power Company; Citizens' Railway Company, Union Railway Company, St. Joseph & Lake Railway Company, and Wyatt Park Railway Company, which form the entire street railways of St. Joseph, comprising about forty miles of trolley line and the entire commercial electric lighting and power business of the city.

CUMBERLAND TELEPHONE GROWTH.—The Cumberland Telephone and Telegraph Company now has 338 exchanges, 49 of which were built and opened during the year, showing a net gain of 15,893 subscribers, making the total December 31, 1902, of 92,425 subscribers. The Cumberland Telephone Company is regarded as one of the strongest of the American Bell Telephone Company's licenses. Its 5 per cent. bonds due in 1918 are selling at 110, while the 7 per cent. stock is at present quoted at 123, having sold as high as 140. The company operates in Kentucky, Tennessee, Mississippi and Louisiana.

THE INTERNATIONAL WIRELESS TELEGRAPH COMPANY, with a capital of $7,500,000 and $1,000 paid, has filed articles of incorporation at Camden, N. J. The objects of the corporation are to purchase or acquire the letters patent for the United States granted to any person or persons covering the discovery of wireless telegraphy and telephony, and the invention, improvement, manufacture and use of apparatus.

DIVIDEND.—The stockholders of the Binghamton Railway Company and the subsidiary companies have received notice that a dividend of 2 per cent. will be paid on their stock on the third day of March next. This is the third dividend of 2 per cent. that has been declared by this company.

Commercial Intelligence.

THE WEEK IN TRADE.—Despite drawbacks due to wintry weather, spring jobbing trade is far in advance of a year ago. For the same reason retail business has been noticeably affected and buying has been lessened temporarily. The favorable side of the weather situation is the heavy fall of snow which has covered the entire surplus-producing winter-wheat belt, putting that plant, temporarily at least, beyond danger from seasonal changes. Wholesale buyers are reported more numerous in all the leading markets and Chicago, St. Louis, New York, Kansas City and Boston and most northwestern cities report active inquiry and increased sales for Spring account with numerous re-orders already noted. Active preparations for a heavy building season are going forward. Jobbing trade is improving in the South, a tone of cheerfulness having been imparted by the advance in cotton. In iron and steel, consumption still leads production in the cruder forms. Finished materials are in active demand, but there is general complaint of delay in making deliveries. There is a special activity in plates, bars and structural material and pipe, the transportation problem, however, still affecting the entire trade. Business in copper was very quiet, brokers complaining of scarcity of orders. The closing quotations are 12.90 to 13c. for Lake and electrolytic, 12.60 a 12.80c. for casting stock, and 12.35c. for Standard. The business failures for the week ending February 19, according to *Bradstreet's* report, aggregated 188, against 217 the week previous and 228 the corresponding week last year.

EQUIPPING STEEL WORKS.—Chairman Bacon, of Tennessee Coal & Iron, says in his annual report that it has been decided to erect immediately a large furnace at Ensley, and later to replace four of the stacks now there with others of much greater capacity. Coke oven gas, which has heretofore been a waste product at nearly all of the ovens, is now used to make steam for hoisting and pumping, and will soon steam the boilers that are to run the electric power and light station, now being constructed to supply all of the furnaces, mills and shops at Ensley. In the same manner the Lackawanna Steel Company, at Buffalo, is to equip immense new works specially with electric power. Its dock and ore bank on Lake Erie, supplied with Buffalo electric power to carry iron ore from boats to the top of the stacks of the blast furnaces and empty them automatically, are all ready for operation. One stack is in blast and produced the first pig iron a few days ago. It has a capacity of 300 tons per day and there will be completed as fast as possible five other stacks, two of which will have the enormous capacity of 800 tons of iron daily. The steel plant, which was originally planned for 1,000,000 tons, will have its capacity increased. The electric power to run the works will be obtained from the Canadian side of the Niagara River, as the electric company will be closely identified with the Lackawanna Steel Company. The proposition is to furnish 30,000 hp at the start and to increase this to 100,000 hp.

SOME ALBERGER CONDENSER ORDERS.—The Alberger Condenser Company, White Building, Liberty Street, New York, has obtained a contract from the Westinghouse Electric & Manufacturing Company, Limited, for a high-vacuum surface condensing equipment for two 1,000-kw Westinghouse-Parsons turbines to be installed in the new extension to the Westinghouse works, East Pittsburg. The centrifugal circulating pump will be electrically driven while the vacuum pump will be operated by a Corliss engine. A contract has also been taken for a condensing equipment of the beforementioned description for the purpose of taking care of two 500-kw Curtis turbines built by the General Electric Company for installation in the Dover (N. H.) plant of the United Gas & Electric Company.

TRAIN LIGHTING.—At a meeting of the directors of the Consolidated Railway Electric Lighting & Equipment Company, held February 11, 1903, Mr. Isaac L. Rice was re-elected president, and J. L. Watson secretary and treasurer. The duties heretofore performed by Mr. John N. Abbott, as vice-president and general manager were added to those of the president, and Mr. Abbott's connection with the company ceased. All communications to this company should be addressed to 100 Broadway, New York.

CONDENSERS FOR CHICAGO COMMONWEALTH PLANT.—The Commonwealth Electric Company, of South Chicago, has just placed a contract with the Alberger Condenser Company, New York, for two high-vacuum condensing equipments with circulating and vacuum pumps. The auxiliaries will be operated by Corliss engines. Each of these equipments will take care of 5,000 kw. This will make three equipments, for which the Alberger people have secured contracts from the Commonwealth Company.

LACHINE RAPIDS POWER COMPANY.—The annual report of the Lachine Rapids Hydraulic & Land Company, of Montreal, shows net earnings, over and above operating expenses, of over 12 per cent. on the paid-up capital. After providing for all fixed charges, bad debts and the usual dividends on a basis of 8 per cent., there was carried forward a surplus of $91,070.

ELECTRIC HOISTS FOR AUSTRALIA.—The Lidgerwood Manufacturing Company, of 95 Liberty Street, New York, has secured a contract from the New South Wales government for two 40-hp double-drum derrick hoists which are to be operated by motors built by the General Electric Company. The machinery is intended to be used on the Sydney docks.

ELECTRICITY FOR MELBOURNE SUBURBS.—Australian advices state that the Victorian Light, Heat & Power Company, Limited, has secured the consent from the local municipal authorities to supply Williamstown, Port Melbourne & Brighton—all suburbs of Melbourne—with electricity for both light and power purposes.

NEW ZEALAND LIGHTING PROJECT.—The New Zealand electrical engineering firm of Wilson & Company, of Wellington, has submitted a proposition to the municipal authorities of Eltham for the electric lighting of that place.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical material from the port of New York for the week ended February 7: Argentine Republic—5 pkgs. machinery, $2,700; 19 pkgs. material, $2,270. Athens—2 pkgs. material, $250. Antwerp—29 pkgs. material, $3,557. Amsterdam—1 pkg. material, $12. Brazil—198 pkgs. machinery, $33,074; 49 pkgs. material, $2,033. British Guiana—78 pkgs. material, $2,030. Berlin—1 pkg. machinery, $62; 3 pkgs. material, $184. British Australia—45 pkgs. machinery, $4,135; 19 pkgs. material, $995. British East Indies—10 pkgs. material, $590. British West Indies—17 pkgs. material, $281; 1 pkg. machinery, $50. British Possessions in Africa—33 pkgs. machinery, $1,190; 66 pkgs. machinery, $5,420. Cowes—25 pkgs. machinery, $1,631. Copenhagen—1 pkg. machinery, $210. Central America—6 pkgs. material, $188. Chili—2 pkgs. material, $172. Christiania—24 pkgs. material, $918. Colombia—23 pkgs. material, $761. Cuba—63 pkgs. material, $2,471. Dutch West Indies—34 pkgs. material, $215. Dutch Guiana—6 pkgs. machinery, $3,838. Egypt—1 pkg. material, $50. Gothenburg—2 pkgs. machinery, $288. Hayti—15 pkgs. material, $364. Havre—18 pkgs. machinery, $1,895; 11 pkgs. material, $268. Hamburg—6 pkgs. machinery, $373; 123 pkgs. material, $5,306. London—67 pkgs. machinery, $13,530; 343 pkgs. material, $8,263. Liverpool—338 pkgs. machinery, $52,749; 22 pkgs. material, $1,209. Lisbon—3 pkgs. material, $9. Mexico—454 pkgs. material $4,725. Manchester—72 pkgs. machinery, $8,113. Milan—1 pkg. material, $80. Middlesborough—1 pkg. machinery, $75. Newfoundland—8 pkgs. material, $260. Nova Scotia—5 pkgs. material, $85. Patras—1 pkg. material, $50. Preston—3 pkgs. material, $3,225. Portuguese Possessions in Africa—53 pkgs. machinery, $4,000. Peru—18 pkgs. machinery, $678. Riga—7 pkgs. material, $350. Southampton—208 pkgs. material, $1,970; 4 pkgs. machinery, $52. San Domingo—6 pkgs. material, $66. Vienna—1 pkg. material, $75.

TELEPHONE FREE DELIVERY.—Though Senator Fairbanks's proposal for an appropriation of $25,000 for an experimental "rural telephone free delivery" will find no place in this year's post office appropriation bill, says a Washington dispatch, it may foreshadow an interesting line of postal development. In many parts of the West almost every farmer has a telephone in his own home, and the service is extending rapidly. Now, Mr. Fairbanks proposes that a special stamp be issued which will denote to the postmaster at the receiving office that the envelope is to be torn open, and the contents telephoned to the person addressed. This would often save the greater part of the day in the rural delivery region, which will soon embrace all the settled parts of the country. Arrangements would be made with local telephone companies for this service. Mr. Lodge objected to the amendment, saying that while our rural free delivery service was still experimental we should not take on new enterprises. Mr. Proctor opposed it as "paternalism run mad," saying that it would be but the entering wedge for the government's delivering express packages or goods from the department stores. The amendment was lost on point of order, but it is likely to be heard from again. The telephone development in the Mississippi Valley has been so extraordinary that its promoters desire to make it contributory to the betterment of the postal service.

EXPORT TRADE.—The export figures furnished by the Treasury Bureau of Statistics continue to indicate that the foreign commerce of the United States is resuming its normal conditions. The January exports were larger than those of any preceding January in the history of our commerce except those of the year 1901, in which the January figures were about $2,000,000 above those of last month. The total value of exports in January, 1903, was $134,040,952, against $136,325,601 in January, 1901; $108,426,674 in January 1898, and $67,673,669 in January, 1893. Turning to the import side, last month's figures show also the largest January imports, being $85,-109,891, against $79,138,192 in January of last year, and $75,168,267 in January, 1893. For the 12 months ending with January, 1903, the total imports approximate the billion-dollar line, being $975,283,637, against $742,068,925 for the 12 months ending with January, 1898. This increase in importations is chiefly due to the continuing demand of the manufacturing interests for raw material from abroad for use in their industries. Exports for the month were nearly $50,000,000 to the good.

GOULD STORAGE BATTERY CONTRACTS.—Among the recent contracts closed by the Gould Storage Battery Company are the following: Philadelphia & Lehigh Valley Traction Company; battery to be located near Quakertown, Pa.; 196 cells in glass jars and switchboard; discharge capacity, 200 amp. Warren Electric Street Railway Company, Warren, Pa.; 240 cells in glass jars, switchboard and Gould regulating booster; discharge capacity, 160 amp. Dayton & Muncie Traction Company, 4 plants, located at Winchester, Ind.; Selma, Ind.; Union City, Ohio; Greenville, Ohio; each battery consisting of 305 cells in lead-lined tanks; plate capacity, 320 amp; tank capacity, 400 amp; switchboard and 44-kw regulating Gould booster. Odell Illuminating Company; battery located at Odell, Ill., consisting of 124 cells in jars; capacity, 240 amp-hours at 240 volts, for three-wire lighting system. Manhattan Heat, Light & Power Company; battery located at St. Paul, Minn., consisting of 56 cells in lead-lined tanks; capacity, 2,080 amp-hours; switchboard and automatic Gould booster for block lighting and regulation.

THE LAWRENCEVILLE MANUFACTURING COMPANY, of Lawrenceville, Va., organized with a capital from $25,000 to $100,000, will build at once a furniture factory to make chamber suits and tables and power house to furnish power. An electric light plant will be installed to furnish Lawrenceville with light. General information, catalogues, etc., are asked from supply houses, machinery makers and electric construction companies. The secretary will furnish data on request. The officers are: Robert Turnbull, president; J. D. Barkley, vice-president; Hugh C. Rirdon, secretary and chairman; O. I. Bostick, treasurer; Charles Hooper, general manager.

A NEW SUPPLY HOUSE IN ST. LOUIS.—The Ewing-Merkle Electric Company has been incorporated in St. Louis to do a strictly jobbing business in electrical supplies and apparatus. The personnel of the company is made up of N. W. Ewing, formerly assistant treasurer; Milton Mill, formerly assistant manager; W. S. Merkle, formerly manager of the engineering department; W. G. Brown, formerly manager of the apparatus department, of the Western Electrical Supply Company. They have rented a six-story and basement building at 1106 Pine Street, and will make a specialty of the jobbing interest in the West and Southwest.

MORE MEXICAN WATER POWER PROJECTS.—Richard Honey, the Mexican mining and railroad capitalist, has acquired a concession granted in 1901 to Juan Fernandez for the purpose of utilizing the waters of the Santa Catarina River on the boundaries of the State of Puebla and Hidalgo at a point called La Cantera. To increase the power, Mr. Honey has applied to the Mexican authorities with a view to including in the concession the necessary rights to permit of employing 5,000 meters of the water from La Cantera up stream and a similar quantity down stream from that point.

LIGHTING AND TRACTION SYSTEM FOR BALLARAT, AUSTRALIA.—The Electric Supply Company, of Victoria, Limited, has been organized for the purpose of installing an up-to-date electric lighting and traction system in the mining town of Ballarat, Australia. Arrangements have been completed for taking over the existing horse tramways and converting them over to electric traction. The overhead trolley system will be employed. The lighting and traction project combined will represent an expenditure in the neighborhood of $600,000.

10,000-HP PLANT TO OPERATE MEXICAN MINES.—An extensive power plant is to be constructed for the purpose of furnishing energy to operate several of the principal mines located in the El Oro district, Mexico. Jose Luis Reguena, one of the prominent mine owners in that section, has secured the requisite concession. The plant, which will be capable of developing 10,000 hp, will be built on the Lerma River. The current will be conveyed for a distance of about 80 miles.

THE LLEWELLYN IRON WORKS, of Los Angeles, Cal., are to be equipped throughout for driving by electric motors. Induction motors will be direct-coupled or belted to lathes, planers and other machinery, and line shafting will be entirely done away with. The Pacific Light & Power Company has recently purchased from the Westinghouse Electric & Manufacturing Company for this plant 20 induction motors, ranging in size from 2 hp to 75 hp, which are now being installed.

ANOTHER MEXICAN WATER POWER PROJECT.—The Dos Estrellas Mining Company is after a concession from the Mexican authorities to permit of the utilization of 25,000 liters of water per second from the River La Cienega. It is proposed to operate the company's reduction works by water power and to furnish the mining town of Tlalpujahua, located in the State of Michoacan, with power for electric lighting use.

LIDGERWOOD ELECTRIC CABLEWAYS.—The Peachbottom Slate Manufacturing Company, of York, Pa., has placed a contract with the Lidgerwood Manufacturing Company for two horizontal cableways with stationary towers. The span will be 700 feet. Each of the cableways will be capable of handling a three-ton load. They will be operated by four 35-hp Westinghouse direct-current motors, series-parallel control.

DE LAVAL TURBINES FOR AUSTRALIA.—J. Bartram & Sons, Melbourne, have placed a contract for two De Laval steam turbine dynamos for installation in their new refrigerating and ice making plants in that Australian city.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has, it is stated, secured the contract for the municipal plant at Nashville, Tenn.

General News.

THE TELEPHONE.

JACKSONVILLE, FLA.—A long distance line between Jacksonville and Miami will probably be built by the Southern Bell Company at an early date.

LA HOGUE, ILL.—A farmers' mutual telephone company is being organized at this place.

OTTAWA, ILL.—The Bureau County Mutual Telephone Company has just been organized at this place.

MANHATTAN, ILL.—The Manhattan Telephone Company has increased its capital stock of $2,400 to $5,000.

BARRY, ILL.—The Pike County Telephone Company intends to build a line from New Canton to Hannibal.

WINDSOR, ILL.—The Windsor Mutual Telephone Company has increased its capital stock from $10,000 to $25,000.

ODELL, ILL.—The farmers north of here have formed a company to build a telephone line between Odell and Nevada.

MASCOUTAH, ILL.—The Mascoutah Electric Light Company proposes to erect and maintain a telephone and telegraph line.

MARTINTON, ILL.—The Local Telephone Company has been incorporated with a capital stock of $10,000 by Horace Barton, J. L. Shaw and E. C. Vanderpoorten.

LONG POINT, ILL.—Long Point Automatic Telephone Company has been organized with a capital stock of $2,500. The incorporators are H. H. Swift, C. E. Goldschmidt and C. W. Johnson.

EAST ST. LOUIS, ILL.—The St. Clair and Eastern Telephone Company, of East St. Louis, has been incorporated with a capital stock of $10,000 by E. M. Evans, C. E. Wise and C. A. Coombs.

BELLEVILLE, ILL.—The Marissa Telephone Company, with a capital of $2,500, has been incorporated by J. A. Hamilton, Henry Finger, R. S. Coulter, A. C. Elder, R. P. Jenson and A. J. Mathews.

ANDERSON, IND.—The Delaware-Madison Telephone Company is considering the question of building a farmers' line.

INDIANAPOLIS, IND.—The Blue River Telephone Company has incorporated to build an exchange in the Friends Church, Blue River, Shelby County. The company will do a local business.

FRANKFORT, IND.—Frank F., and Victor Smith, local capitalists, have become interested in the local telephone company and improvements will be made in the system calling for the expenditure of a large sum of money.

OAKLANDON, IND.—The Oaklandon Telephone Company, with a capital stock of $1,000, has been incorporated by John Moore, J. M. Emery, F. M. Kimberlin, Henry Alford, J. T. Newkirk, O. A. Klepper and T. A. Silvey, all of Oaklandon.

NICHOLS, IOWA.—The Nichols Mutual Telephone Company will establish a local exchange.

NEW HAMPTON, IOWA.—The Sumner Telephone Company has applied for a franchise in this place.

JORDAN, IOWA.—A company will soon be formed to start a new telephone line west and south of Jordan.

THORNTON, IOWA.—The Latimer Telephone Company has been granted a local franchise and will begin work soon.

AVOCA, IOWA.—The Harlan & Avoca Telephone Company is planning to extend its lines to Council Bluffs and South Omaha.

STORM LAKE, IOWA.—W. L. Geisinger, of this city, proposes to construct a telephone line from Storm Lake to Spencer and intermediate points.

WATERLOO, IOWA.—The Commonwealth Telephone Company has been incorporated with a capital of $900,000 by R. C. Dawes, C. B. Geist, A. G. Wheeler, Jr., and others.

LIBERTYVILLE, IOWA.—The Libertyville Telephone Company has been incorporated with a capital of $7,000. Among those interested are Ed. Glotfelty, S. K. Davis, J. G. Hutton and Lew Fordyce.

SIOUX CITY, IOWA.—The Sioux City Telephone Company has asked the city council for a franchise to establish a system here. Among those interested are T. A. Thompson, Wm. Milchrist and E. W. Rice.

BOWLING GREEN, KY.—The Home Telephone Company recently organized here, has elected officers as follows: President, Nerge Clark; vice-president, E. H. Stout; secretary, W. B. Mayes; treasurer, J. W. Porter.

BOWLING GREEN, KY.—An independent telephone company headed by Nerge Clark, E. H. Stout and others is putting in a new telephone system at Bowling Green. The capital stock of the company is placed at $100,000.

BETHEL, ME.—The Androscoggin Lakes Telephone and Telegraph Company has been organized with a capital stock of $5,000. Mr. T. Peasle, of Upton, Me., is president.

BOSTON, MASS.—The Cape Cod Telephone Company, with a capital stock of $1,000, has been incorporated. Mr. F. P. Goss is president, and Arthur G. Guyer, treasurer.

ONONDAGA, MICH.—A new telephone company has been organized here with Frank Gukland as president.

FLINT, MICH.—The Bell Telephone Company is making preparations to place its wires underground in this city.

DETROIT, MICH.—The Michigan Telephone Company has just completed a two-wire long distance line between Bay City and Alpena.

GIBBON, MINN.—The Gibbon Telephone Company has been incorporated with $10,000 capital stock.

CASTLE ROCK, MINN.—A telephone line is projected to Farmington. C. A. Thompson is interested.

HAMMOND, MINN.—A movement is on foot to organize a new telephone line to cover the country trade.

NORWOOD, MINN.—The Norwood-Young America Telephone Company has been incorporated with a capital stock of $50,000 by Geo. J. Bradley, Geo. W. Ocobock, J. D. Krause and others.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will make extensive improvements in the Northwest during the year. A number of toll lines will be built in Minnesota and between Minneapolis and Duluth.

ST. PAUL, MINN.—The Jasper Telephone Company, of Jasper, has incorporated with a capital stock of $1,500. The incorporators are W. W. Stearns, Alexander Mitchell, E. P. Le Seur, P. O. Olson, M. D. Martin, I. Turner, S. S. King, A. W. Jameson, Andrew Carlson, J. H. Berg, John Peterson, J. H. Taylor and Andrew Rae.

ARLINGTON, NEB.—The Arlington Telephone Company will erect an exchange building in this city.

PLATTSMOUTH, NEB.—The Local Independent Telephone Company is contemplating the erection of a new exchange building in this city, and one for Havelock.

OMAHA, NEB.—The Nebraska Telephone Company will increase its capital stock from $1,800,000 to $2,400,000 for the purpose of extensions and improvements in Nebraska and Iowa. The company will establish new exchanges in Omaha, Lincoln and Council Bluffs. The wires will be laid underground in the latter city.

CHARLOTTE, N. C.—It is reported that the Southern Bell Telephone Company has bought a 21-mile independent line between Charlotte and Gastonia.

TRENTON, N. J.—The Central New Jersey Telephone Company has been incorporated with a capital stock of $100,000.

NEW BRUNSWICK, N. J.—The People's Co-operative Telephone Company has been incorporated here with a capital stock of $100,000.

TRENTON, N. J.—The Central Illinois Telephone and Telegraph Company has been incorporated here, with a capital stock of $500,000, by L. B. Daily, K. K. McLaren and H. O. Coughlan.

BUFFALO, N. Y.—The Haines Telephone Company has increased its capital stock of $20,000 to $100,000.

BUFFALO, N. Y.—The Independent Union Telephone Company, of Buffalo, has increased its capital stock from $200,000 to $1,000,000.

WAYLAND, N. Y.—The Wayland Independent Telephone Company has been incorporated with a capital stock of $5,000. The directors are G. M. Peabody, G. E. Whiteman and Alexander Engel, of Wayland, N. Y.

SYRACUSE, N. Y.—The Syracuse Telephone Company will place its wires in conduits under the Erie Canal at Salina Street. There will be a manhole at either side of the waterway. The contract has been given to C. J. Sullivan for the construction of nine iron ducts.

WAPAKONETA, OHIO.—The St. Mary's Telephone Company will rebuild its entire system.

MARSHALLVILLE, OHIO.—The Marshallville Telephone Company has increased its capital stock from $1,000 to $10,000.

CINCINNATI, OHIO.—The Board of Fire Trustees contemplates making extensive improvements in the fire alarm service. It is proposed to secure an issue of $125,000 in bonds, part of which will be used in the installation of underground fire alarm telegraph cables and an improved switchboard. A new building will also be erected for the accommodation of the new telegraph system.

PHILADELPHIA, PA.—The annual meeting of the United Telephone & Telegraph Company, of Harrisburg, was held in this city. The following named officers were elected: R. G. Park, president; W. D. Barnard, vice-president; E. A. Scott, secretary, and S. R. Caldwell, treasurer.

GEORGES, S. C.—The Georges Telephone Exchange has been incorporated by R. L. Weeks, M. S. Conner and D. S. Dukes. The capital stock is $5,000.

MEMPHIS, TENN.—The Bald Knob Telephone Company, of Bald Knob, has been incorporated with a capital stock of $5,000. E. R. Wynn is president, George Dickey, vice-president, and L. G. Wynn, secretary and treasurer.

RICHMOND, VA.—The Richmond Telephone Company, recently absorbed by the Bell, has issued notice that it will discontinue business after Feb. 28.

FREDERICKSBURG, VA.—The directors of the Upper Rappahannock Telephone Company have decided to run the line across the Rappahannock river at Port Royal.

MONTEREY, VA.—At the annual meeting of the stockholders of the Monterey and Staunton Telephone Company officers were elected as follows: J. C. Matheny, president; F. Glen Mauzy, secretary and treasurer, and E. H. McClintic, general manager.

MARINETTE, WIS.—The Superior Construction Company, of Superior, has petitioned for a telephone franchise in this place.

MILWAUKEE, WIS.—The Western Wisconsin Telephone Company, of Arcadia, has increased its capital stock of $35,000 to $40,000.

MILWAUKEE, WIS.—The Wind Lake Telephone Company, of Norway, Racine Co., has been incorporated with a capital stock of $3,000 by Charles Flett, J. E. Jacobson and Otto E. Schmidt.

WAUSAU, WIS.—The annual meeting of the stockholders of the Wausau Telephone Company was held here a few days ago. The present officers were re-elected. The annual report shows the company to be in a satisfactory financial condition. The company has 525 telephones in use.

ELECTRIC LIGHT AND POWER.

AUGUSTA, ARK.—P. H. Porter, of Clinton, Ky., has secured the contract for an electric light plant.

BLACK HAWK, COL.—The council has granted the Seaton Mountain Electric Light & Power Company an electric light franchise.

TRINIDAD, COL.—It is stated that the Las Animas Light, Power & Mfg. Company is to increase the capacity of its gas and electric plants and extend the system.

SOUTH NORWALK, CONN.—Bids will probably be received in March for an extension to the electric light plant here.

SEAFORD, DEL.—The Town Council will borrow $10,000 for an electric light plant.

ALBANY, GA.—Smith D. Pickett and Chas. E. Garner, of Jacksonville have purchased a water power near Albany for $6,000. A power plant may be erected.

ATLANTA, GA.—The S. Morgan Smith Company, of York, Pa., has secured right of way for transmitting power to Atlanta from the power plant on the Chattahoochie river.

ATLANTA, GA.—J. Frank Lester has made a proposition to the city to erect a lighting plant in connection with the city crematory where lights may be furnished for the city at $30 each, instead of at $82.50, the present price.

ALBANY, GA.—The Albany Power and Manufacturing Company, of Albany, has applied for a charter. Alex. W. Smith and others are the petitioners. The capital stock will be $200,000, with the privilege of increasing to $500,000.

EDWARDSVILLE, ILL.—The Edwardsville Electric Light Company has been granted a franchise.

VENICE, ILL.—The Venice and Granite City Electric Light and Power Company will erect a new power house.

QUINCY, ILL.—C. E. Mead, of Quincy, is general manager of a company being formed to construct an electric light plant, at a probable cost of $150,000.

MORRISON, ILL.—The Morrison Electric Light Company has been incorporated, with a capital of $40,000, by A. V. Viner, Luther R. Ramsey and Saml. L. McCalmount.

GREENCASTLE, IND.—Bids will soon be asked for the electric light plant of the Putnam Electric Company.

ALEXANDRIA, IND.—Suit has been brought to have a receiver appointed for the Alexandria Electric Light & Power Company.

JEFFERSONVILLE, IND.—It is stated that the United Gas & Electric Company will make extensive improvements to its plant.

DECATUR, IND.—The Warring Glove & Mitten factory will purchase a large installment of electric machinery for its plant here.

CAYUGA, IND.—Mr. Barford, of Washington, is reported to have secured the contract for an electric light plant and water works for Cayuga, for about $30,000.

BLUFFTON, IND.—The Olds Construction Company, of Ft. Wayne, Ind., has secured the contract for constructing the electric light plant in this city for $15,000.

SOUTH BEND, IND.—A. M. Barrow, of this city, is at the head of a syndicate which proposes to organize a public utility company for Indiana and consolidate electric light and water plants which have proved unprofitable to stockholders. The syndicate has already secured fifteen plants.

RICHMOND, IND.—The report of the municipal electric light commissioners for the month of January shows municipal ownership is making a failure to the tune of nearly $2,000 per month. The report shows that the plant cost the city during the month $1,277.56. At the beginning of the month the commissioners had a balance of $1,539 and the cash on hand Jan. 31 was $261. This brings the cost of the plant to the city of $1,779.91 over and above the receipts.

MUSCATINE, IA., is asking until March 10 for bids on street electric lighting for ten years with 100 arc lamps.

STRATFORD, IA.—It is stated that Allen Cox, of Linnsburg, will construct an electric light plant to furnish light to Stratford and Dayton.

ST. MARTINSVILLE, LA.—Bids will be received by H. C. Fournet, Chairman Executive Committee on Water and Light, until March 3, for all machinery, apparatus, material and supplies for a water and light plant.

SHREVEPORT, LA.—As a result of the strike among linemen in this city the mayor issued an order suspending the electric light and street railway service. This order was necessitated by the sympathizers of the strikers cutting the wires.

NEWBURYPORT, MASS.—It is stated that the Newburyport Gas & Electric Light Company will construct and equip a new electric light station. W. R. Johnson is president.

SPRINGFIELD, MASS.—Mr. Samuel Rockwell has applied for an act of incorporation for an electric power and light company. It is proposed to use the water of Crystal Lake and the power of the Foxville plant. From Crystal Lake to the foot of the Foxville fall, a 200 ft. fall is available.

BOSTON, MASS.—The Edison Electric Illuminating Company, of this city, has purchased the Natick Gas and Electric Company and the Framingham Electric Company. The Edison Company has already obtained control of the Somerville and Woburn companies and its purpose is said to be the control of all the suburban electric lighting business.

IRON MOUNTAIN, MICH.—It is stated that the Iron Mountain Electric Light & Power Company will expend about $20,000 in improvements.

ST. JOSEPH, MICH.—Congress has reported favorably on the bill permitting the construction of a dam across St. Joseph River in Berrien County, Mich.

LAKEPARK, MINN.—Bids are wanted March 2 for $11,000 electric light and water bonds. O. Larsen is Recorder.

DULUTH, MINN.—The Highland Canal & Power Company will develop the water power of St. Louis River for electrical purposes.

JACKSON, MISS.—Thos. McClelland, of Jackson, is at the head of a new company proposing to put in an independent lighting plant.

NATCHEZ, MISS.—The stockholders of the Natchez Gas Light Company are considering the matter of selling their electric light plant, which may be bought by the Natchez Electric Street Railway Company.

ST. LOUIS, MO.—The King Electric Light Company, of De Hodiamont, has been granted a franchise in St. Ferdinand and Central townships.

HIGH POINT, N. C.—The High Point Electric Company has been incorporated, with $50,000 capital, by W. S. Thompson, of Greensboro, and others. The plant is now owned by C. M. Richardson.

RALEIGH, N. C.—A movement is on foot here for the combination of the street railway system, the gas and electric lighting plant and the big power plant at Milburnie on the Neuse River.

HUDSON, N. H.—A bill has passed second-reading in the House to authorize the town to establish an electric light plant, and construct water works.

TRENTON, N. J.—The Bozeman Light & Traction Company has been incorporated at Jersey City with a capital stock of $500,000 for the purpose of operating gas plants, electric, heat and power plants, etc. The incorporators are Charles H. Hendrickson, Jr., John M. Quinn and Jay Noble Emley.

LIVERPOOL, N. Y.—Fred Wyker has been granted a franchise to light the village by electricity.

WATERTOWN, N. Y.—The People's Power & Light Company, of Watertown, has been incorporated, with a capital of $60,000, by J. M. Carpenter and G. H. Smith, of Watertown.

ALBION, N. Y.—It is reported that the Albion Power Company, which has purchased the plant of the Brockport Electric Light Company, will enlarge and improve the Waterport plant and improve the central station in Albion.

NEW YORK, N. Y.—The United States Light & Heating Company has elected officers as follows: R. H. Beach, president; W. J. Arkell, vice-president; Chas. S. Furst, of Jersey City, secretary and treasurer, and A. Sandford Adler, general manager.

MEDINA, OHIO.—The Medina Electric Illuminating Company has been incorporated with a capital stock of $25,000.

CLEVELAND, OHIO.—A resolution has been introduced in the Board of Control, calling for municipal street lighting.

WILMINGTON C. H., OHIO.—The United Water & Light Company is stated to have purchased the electric light plant of the city.

HARRISON, OHIO.—It is proposed to issue $25,000 in bonds for the purpose of purchasing the electric light plant and water works now in operation in this place.

OAK HARBOR, OHIO. The plant of the Oak Harbor Electric Light Company has ceased operation, owing to the inability of the company and the town authorities to agree as to charges for arc lights. The present rate is $50 per light, but the company asks $65.

OTTAWA, ONT.—The Consumers Electric Company has increased its rates for current from 8 cents per kw-hour to 12 cents, allowing 40 per cent. discount on payments within fifteen days; thus making a net rate of 7⅕ cents per kw-hour.

PENDLETON, ORE.—It is reported that the Pendleton Electric Company will double the capacity of its plant at a cost of about $20,000.

FT. STEVENS, ORE.—Bids will be received by F. H. Hathaway, Vancouver Barracks, Wash., on March 6 for furnishing and delivering material for the construction of an electric light plant at this post.

UNION, S. C.—T. C. Duncan, of Union, is interested in a big scheme to utilize the water power of Broad River and bring electric power to Union for commercial purposes.

DOLAND, S. D.—Wm. Wells will receive bids about June 1 for the construction of an electric light plant.

WHITE LAKE, S. D.—If private parties cannot be induced to construct an electric light plant here the citizens will urge the town to establish a plant, to cost about $4,000.

KNOXVILLE, TENN.—The Knoxville Power Company, it is stated, has been authorized to dam the Little Tennessee River.

SPRINGVILLE, UTAH.—The citizens have voted to issue $20,000 bonds for the construction of an electric light plant.

ALEXANDRIA, VA.—An engineer will be employed to prepare plans for an electric light plant.

PETERSBURG, VA.—The council of Petersburg has invited bids from the Virginia Passenger and Power Company for lighting the city for a term of years. The company offers to furnish arc lights at $57 per year each, if a five-year contract is made.

BLUEFIELD, W. VA.—The Bluefield Railway, Light & Power Company has been incorporated, with a capital stock of $10,000, by S. R. Bullock, C. C. Brown, John W. Avery, A. C. Bagg, F. B. Daniels, New York City.

BRUCE, WIS.—It is reported that the Bruce Electric Light Company will construct a plant.

BELOIT, WIS.—The city is figuring on a complete electric light system, to consist of about 20 miles of wire, 250 arc lights and incandescents according to demand. Robert Caldwell is city engineer.

THE ELECTRIC RAILWAY.

OPELIKA, ALA.—An electric railway will be built at Opelika. The new company has purchased the plant of the local electric light company.

HARTFORD, CONN.—The West Side Street Railway Company, of Stonington, is seeking a charter.

HARTFORD, CONN.—The Middletown & Meriden Traction Company is seeking incorporation. It plans to build from Highland Station to Meriden.

HARTFORD, CONN.—The Willimantic & Southbridge Street Railway Company has applied to the Legislature for permission to increase its capital stock to $200,000. The plan of the company is to build an electric railway to connect Willimantic, Conn., and Southbridge, Mass.

WOODBURY, CONN.—The application of the Woodbury & Waterbury Street Railway Company for incorporation has been presented to the Legislature. The incorporators are Floyd F. Hitchcock, Levi A. Curtiss, of Woodbury; Christian Stroebel, of Waterbury, and Fred L. Averill, of Bradford. The capital stock is to be $200,000.

DELAWARE CITY, DEL.—It is proposed to build an electric railway between Milford and Delaware City. H. L. Evans, of the Wilmington and New Castle Railway Company, is said to be interested.

ATLANTA, GA.—The dispute between the Georgia Railway and Electric Company and the city of Atlanta over the company's taxes for 1902 has been settled by the company's paying to the city $23,695.

ATHENS, GA.—The J. Morgan Syndicate, builders of electric and steam railroads, Toledo, Ohio, have written to the mayor of Athens expressing a desire to work up a company to build an electric railway to Atlanta, Washington and other towns.

ATLANTA, GA.—The Chattahoochee Terminal Railway Company, capital $250,000 is being organized at Atlanta to build a line to Marietta, 20 miles distant. The petitioners for a charter are represented by Thos. A. Gramling, N. A. Morris and others. The company asks for the privilege of increasing its capital to $2,000,000.

BOISE, IDAHO.—Howard Sebree, of Caldwell, has applied for the right of way for the construction of an electric railway from Boise to Caldwell, a distance of 30 miles.

SYCAMORE, ILL.—The De Kalb-Sycamore Electric Railway Company plans to extend its lines to Belvidere.

CHICAGO, ILL.—The City Council has granted an ordinance to construct a mile of track on Western Avenue, to connect the cross-town lines of the Chicago City Railway and the Chicago Union Traction Company. The ordinance becomes effective only after these two companies make an operating agreement whereby transfers will be exchanged.

EAST ST. LOUIS, ILL.—The Interstate Transit Company will put in operation April 1, twenty-four improved electric automobiles, forming a passenger service scheduled to traverse the greater portion of the East St. Louis thoroughfares. Until a few weeks ago this company operated an automobile line over Eads bridge, which received a liberal patronage. For the purpose of charging the batteries the company will utilize a power plant which is now being established in East St. Louis.

RICHMOND, IND.—The Richmond Street & Interurban Railway Company will build an extension from Milton to Connersville.

MT. VERNON, IND.—The city council has granted a 50-year franchise to the Evansville, Mt. Vernon & Union Town Traction Company.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company is furnishing power for the grist and other mills in this city. The company promises to have such patrons all along the line.

LOGANSPORT, IND.—The Knox, Chicago & Northern Traction Company has been organized to build an electric railway 140 miles long. The company is to be capitalized at $150,000. J. C. Fletcher, of Knox, is president.

INDIANAPOLIS, IND.—The Indianapolis, Columbus and Southern Traction Company has filed a mortgage to secure its issue of bonds lately sold in the East. The mortgage is for $1,000,000, but at present only $300,000 of the bonds will be issued. The money is to provide for extensions and betterments.

GREENWOOD, IND.—The name of the Indianapolis, Greenwood & Franklin Railway Company has been changed to Indianapolis, Columbus & Southern Traction Company, and the capital increased from $150,000 to $285,000. A bond issue of $300,000 has been ratified by the directors. The headquarters of the company will be moved to Columbus.

SOUTH BEND, IND.—Employees of the Indiana Railway Company went on strike a few days ago and as a result the cities of South Bend, Mishawaka, Elkhart and Goshen were practically without car service. The strike was caused, it is said, through the discharge of ten men who were officers of the union. The union now demands that the company reinstate the discharged men, grant a nine-hour day schedule, adjust greivances by arbitration, recognize the union and pay 20 cents an hour on city runs, $2.25 a day on interurban runs and 25 cents an hour overtime. The company carries the mail between South Bend and Goshen and trouble will result if the mails are held up.

LOUISVILLE, KY.—The Louisville, Anchorage & Pewee Valley Electric Railway Company has increased its capital stock to $1,250,000. The charter has been changed to enable the company to build to Shelbyville, Frankfort, Eminence and Mt. Eaton.

AUGUSTA, ME.—A bill has been introduced in the Legislature to incorporate the Winterport, Frankfort & Prospect Electric Railway.

ELKTON, MD.—The City Council has granted a franchise to the Cecil & Kent Electric Company.

PITTSFORD, MICH.—Dr. Ducket, of Toledo, and C. B. Bettis, of Adrian, are projecting an electric railway from Adrian to Hillsdale to pass through this place.

GRAND LEDGE, MICH.—The organization of the Michigan Central Traction Company was perfected at a meeting held here a few days ago. The company is capitalized at $1,500,000. The officers are Samuel Burgert, of Cleveland, president; J. W. Ewing, of Grand Lodge, assistant treasurer; E. F. Pangborn and A. J. White, of Battle Creek; Warren Craig, R. Rosenstock, Samuel Burgert, of Cleveland, F. H. Goadby, of New York, J. S. Mudge, of Grand Ledge, directors.

GLASGOW, MO.—A charter has been granted to the Central Missouri Electric Railway with a capital stock of $4,000,000.

ST. LOUIS, MO.—The St. Louis Suburban Railway Company filed articles showing that it had made an increase in its capital stock from $3,000,000 to $7,500,000. The St. Louis & Meramec River Railway Company has increased its capital stock from $2,000,000 to $3,000,000.

DURHAM, N. C.—J. S. Manning, R. H. Wright and H. A. Fanshee are named as incorporators of the Chapel Hill Trolley Company, which proposes to build a line from Durham to Chapel Hill, a distance of 12 miles.

BUFFALO, N. Y.—The Buffalo & Depew Electric Railway has been granted a franchise to extend its line through Le Roy.

CANISTEO, N. Y.—The Canisteo, Jasper & Woodhull Railway Company has obtained authority from the State Railroad Commissioners to construct its proposed road.

TOLEDO, OHIO.—The Toledo & Western Railway Company has re-elected the present officers.

ASHTABULA, OHIO.—The Ashtabula & Lake Shore Railway Company has been formed by L. A. Robinson, W. S. McGheehan, Frank Hood and others.

WOOSTER, OHIO.—The Wooster & Mansfield Railway Company has elected these officers: W. A. Craig, president; J. B. Keys, vice-president; David Collier, secretary, and J. C. Chretown, treasurer, all of Shreve.

BUCYRUS, OHIO.—The Buckeye Traction Company has awarded a contract for the construction of the first section of its road between Norwalk and Plymouth. Later the road will be extended to Bucyrus.

CINCINNATI, OHIO.—The Cincinnati & Columbus Traction Company has decided to adopt the overhead trolley system instead of the third rail system as originally planned. Contracts will be closed in the very near future.

CLEVELAND, OHIO.—The Cleveland City Railway Company has issued $1,000,000 worth of new stock at par, which is 10 points below the present selling price. The capital stock is increased from $8,000,000 to $9,000,000.

XENIA. OHIO.—The Xenia & Wilmington Traction Company is planning to erect a large power station at Xenia to supply its own road as well as the Springfield & Xenia railway which has no power house of its own. Charles Orr, of Cleveland, is interested in both companies.

EAST LIVERPOOL, OHIO.—President Healey, of the East Liverpool Street Railway, announces that important improvements are to be made to the system. A number of new cars have been ordered and a 250-hp boiler is to be installed in the power station. A portion of the road will be double tracked and other portions of the road will be relaid.

COLUMBUS, OHIO.—Colonel Albert A. E. Boone, of Zanesville, has incorporated two companies for the purpose of encircling Cleveland and Columbus with belt lines. The Cleveland line is incorporated as the Cleveland Manufacturers' Belt Line & Terminal Railway Company, while the Columbus company is known as the Columbus Belt Line & Terminal Railway Company. Both have temporary capital stock of $10,000.

COLUMBUS, OHIO.—The Scioto Valley Traction Company has awarded contracts to the Bullock Electric Company, Cincinnati, for two 1000-kw alternating current generators, five 400-kw rotary converters, fifteen 150-kw and six 370-kw transformers. Contract for the high tension line has been placed with the Pittsburg Reduction Company. The power house will be at Reese's Station and plans have been prepared by W. E. Baker, New York.

CLEVELAND, OHIO.—Extensive improvements will be made to the Cleveland street railway system during the coming season and it is stated that the Cleveland City Railway Company and the Cleveland Electric Railway Company will expend $1,500,000 in betterments. The Cleveland City Railway Company will extend its Clifton boulevard line to Rocky River and will also extend its West Madison Avenue line. It will also extend its Collinwood line to connect with those of the other company. The Cleveland Electric Railway Company is installing a new storage battery station at the Wildermere barns and another will be built at Newburg. Its line from East Cleveland to Euclid will be double tracked.

CARLISLE, PA.—The York and Gettysburg Street Railway has been incorporated by C. C. Basehore, E. J. Wilkes, C. M. Ligget, E. M. Biddle, Jr.; J. L. Zug and J. S. Shapley.

SPRING CITY, PA.—The Montgomery & Chester Electric Railway Company and the Schuylkill Valley Illuminating Company have authorized the expenditure of $120,000 in improvements.

PITTSBURG, PA.—The main office of the Pittsburg, McKeesport & Connellsville Railway Company and all the affiliated light companies have moved to and are now located in the Title & Trust Building, Connellsville, Pa. The million dollar power plant of the railway company will be put in operation within thirty days and power wil be delivered from this plant to all points of the system just as soon is the high tension lines are completed. The main links in the system are being rapidly closed up and the final bridges are being erected so that the entire road will be in operation in the near future, with the exception of the extensions which are to be built this summer. The company has recently completed a very nice layout of new shops at Connellsville, and is in the market for the equipment for these shops. Mr. Thos. Elliott is general manager.

HARRISBURG, PA.—The following named street railway companies have been incorporated: Elizabethtown & Middletown Street Railway Company, capital stock, $54,000, President, Edward Bailey, Harrisburg. Directors: H. K. Alwine, A. L. Etter, Middletown; H. H. Nissley, E. E. Coble, H. C.

Lewis, H. K. Blough, Elizabethtown; John E. Fox, Harrisburg; Isaac R. Herr, Lancaster. Meadville, Conneautville & Albion Traction Company, capital stock, $100,000, President, J. J. De Kinder, Philadelphia; Directors: J. J. De Kinder, J. H. McNeal, R. M. Anderson, L. M. A. Stifel, A. C. Wood, Philadelphia. Lake Erie & Albion Traction Company, capital stock $72,000, President, J. J. De Kinder, Philadelphia. Directors: J. J. De Kinder, J. H. McNeal, R. M. Anderson, L. M. A. Stiefel, A. C. Wood. Philadelphia Girard & Conneaut Traction Company, capital stock $36,000, President, Robert L. Forrest, Philadelphia. Directors: Robert L. Forrest, M. M. Freeman, John H. Cromie, Jr., J. H. McNeal, Philadelphia; Walter H. Wood, Holmesburg. Monaca Heights Street Railway Company. Capital stock, $7,500. President, James H. Welch, Monaca. Directors: John T. Taylor, Frederick Bechtel, Edward Kaye, Walter G. Moffat, Monaca. Sewickley & Leetsdale Electric Street Railway Company, capital stock $18,000, President, J. H. Park, Beaver. Directors: W. A. Park, J. D. White, Rochester; John Warren, Beaver Falls; J. M. Beal, Beaver. Hall Park Street Railway Company, capital stock $18,000, President, T. N. Barnsdall, Pittsburg. Directors: Robert C. Hall, C. V. Reid, William M. Robinson, Pittsburg; Chester Glass, Spokane, Wash.

COLUMBIA, S. C.—The Columbia Electric Street Railway Company has bought out the local gas company and the two companies consolidated.

WARE SHOALS, S. C.—The Ware Shoals Manufacturing Company contemplates building a 5-mile road, to be operated probably by electricity. W. B. Smith Whaley, of Columbia, S. C., is interested.

LEXINGTON, S. C.—Col. G. T. Graham has bought Ranch Shoals on Saluda river near Lexington and a large power house will be erected. It is presumed that the purchase was made for the proposed Lexington-Columbia electric railway.

MINERAL CITY, WASH.—Fred E. Sander is interested in a plan to build an electric railway to connect Index and Mineral City, 14 miles distant.

BLOOMINGTON, WIS.—Local interests propose incorporating a company to build an electric railway from Bloomington to Dubuque.

NEW INDUSTRIAL COMPANIES.

PORTER & BERG have incorporated, in Chicago, with a capital stock of $30,000, to manufacture electrical apparatus. Messrs. J. W. Porter, M. I. Berg and L. C. Howard are interested.

THE UNION ELECTRIC LAMP AND GLASS COMPANY, of Kentucky, has been incorporated in Delaware, with a capital stock of $300,000, by Albert H. Kreitler and George F. Haynes, of Owensboro, Ky.

THE METROPOLITAN BUREAU ELECTRICAL AND MECHANICAL MAINTENANCE COMPANY, St. Louis, Mo., with a capital stock of $50,000, has been incorporated by Samuel Barnes, B. C. Seaton and W. F. Seaton.

THE CRYSTAL PALACE POWER COMPANY, of Arizona, has been incorporated under the laws of that territory with a capital stock of $2,000,000, of which $50,000 is to be employed in Missouri. The company will maintain an office in St. Louis.

THE GIBBS ENGINEERING AND MANUFACTURING COMPANY, of Corning, N. Y., has been incorporated with a capital of $1,000,000 to manufacture motors. The directors are Samuel Riker, Jr., Percy I. Fuller and Charles M. Kirby, New York.

THE IGNITO COMPANY OF NEW ENGLAND has been organized at Portland, Me., to deal in lighting and heating apparatus. The capital stock is $150,000. Mr. Frank M. Copeland, of Newton, Mass., is president and J. L. Jellerson, also of Newton, is treasurer.

OBITUARY.

MR. WALTER A. HUSTON, for fifteen years superintendent of the People's Light and Power Company's plant, died last week, at Orange, N. J. He was fifty years of age, and was born in Pennsylvania. He leaves a widow and three daughters.

LEGAL.

NEW YORK SUBWAY CONDUITS.—The Appellate Division of the Supreme Court of the State of New York has unanimously reversed an order of the Supreme Court denying Subway Contractor John B. McDonald's application for a mandamus to compel Controller Grout to issue a warrant for the payment of $400,000 for certain extra work brought about in a change in the plans for the construction of the underground road. The question before the court was whether this extra work was part of the road's construction or part of its equipment—if the latter, Mr. McDonald was to bear the expense, if the former, the city. When the contract between Mr. McDonald and the city was first entered into the question of motive power was to be subsequently determined. It was however contemplated at the time that if electricity was chosen the wires, etc., were to be strung in the tunnel itself. After Mr. McDonald had proceeded for some time with the construction of the road, it was decided that the wires should be placed in conduits in the sidewalls of the subway. This made necessary a greater excavation to one side and the construction of brick conduits. The court holds that the brick conduits are an integral, inseparable part of the wall. "Being such," said Justice Hatch, for the court, "the city has the absolute title to the whole structure, and it seems to me absurd to say that the contractor can share any ownership therein or the city any lien thereon."

PERSONAL.

MR. THOMAS J. FAY is no longer associated with the Storey Motor & Electric Company, of Harrison, N. J.

PROF. R. H. THURSTON, of Cornell University, is to lecture before the New York Electrical Society next month on steam turbines, a subject of great interest to all classes of electrical men.

MR. W. D. RAY has become connected with the Westinghouse Traction Brake Company to represent its air brakes and magnetic brakes in the Central States, with headquarters at the Union Trust Building, Detroit, Mich.

MR. F. V. L. TURNER has resigned his position as general manager of the Standard Telephone Company, of Atlanta, Ga., and accepted the general managership of the Federal Telephone Company, of Cleveland, Ohio.

PROF. JOHN M. BARR, of the Department of Mechanical Designing of Cornell University, has been engaged as general manager of the Smith Premier Typewriter Company, of Syracuse, N. Y., and will assume the duties at once.

MR. CHARLES C. GALBRAITH has resigned as general manager of Armour & Co., and has become one of the vice-presidents of the De Forest Wireless Telegraph Company, and treasurer of the American De Forest Wireless Telegraph Company.

MR. W. J. HAMMER made an interesting exhibit before the New York Academy of Medicine last week, of the sample of radium given him by Mr. Curie, and already brought by him to the attention of the American Institute of Electrical Engineers.

MR. BEVERLY R. VALUE, third division engineer of the Rapid Transit Commission, of New York City, has resigned to accept a position with the Toronto Light and Power Co. He had charge of the underground work north of One Hundred and Fourth Street, on the Manhattan-Bronx subway. At the last meeting of the commission C. V. R. Powers, now chief assistant to Mr. Value, was chosen as the latter's successor.

MR. C. T. YERKES.—Speaking at the Mayor of Kensington's dinner, in London, last week, on schemes for the improvement of London transportation, Mr. C. T. Yerkes said that so far as he was concerned, it was not a matter of making money with him. He could make more money by remaining in America, but he had got to the point now where he did not care so much for that. What he wanted to do was to accomplish something for the British metropolis.

MR. FRANK B. RAE, consulting electrical engineer, New York City, has arrived at Parral, Mexico, and is looking over the ground at the mines of the Terrenates Consolidated Mining Company preparatory to the installation of a complete electrical equipment. The plant will consist of two 300-hp De Laval turbine dynamos of 200-kw each, two 50-hp electrical hoists and two 350-gal. pumps. Power will be transmitted on aluminum conductors 1¼ miles to the distributing center. These are the first De Laval turbines to be installed in a Mexican mine—probably the first in Mexico—and it is believed that the plant will be one of the most economical in the district.

MR. ANDREW CARNEGIE.—Announcement was made last week of an additional gift of $125,000 by Andrew Carnegie to the endowment fund of the Carnegie Engineering Laboratory of Stevens Institute. The gift was in railroad bonds, and was sent to Alexander C. Humphreys, the new president of the institute. This gift makes the third to the institute by Mr. Carnegie, all of them applied to the Laboratory of Engineering, at the dedication of which on Feb. 6 of 1902 he chose his own epitaph: "Here lies a man who knew how to get around him men who were cleverer than he." The original gift for the laboratory was $50,000, made on May 20, 1899, for the erection of the building. The second was $100,000 as a laboratory endowment fund.

MR. W. D. SARGENT, the amiable and popular vice-president of the New York & New Jersey Telephone Company, was married last week at Somerset, Pa., to Miss Mary Kooser, daughter of Judge Kooser. The party from Brooklyn had a lively time getting there, owing to the heavy snow storm. Their train over the Pennsylvania Railroad was four hours late and it missed connections with the morning train over the Baltimore and Ohio. The afternoon train would not arrive at Somerset until two hours after the time set for the wedding. The couple had also arranged to start on the afternoon train for their bridal trip. No engine was available except a yard shifter. It was speedily attached to the car in which the party was travelling and rattled off the forty miles of snow-drifted roadbed in an hour, bringing in the bridegroom and his party to Somerset a short time before the hour set for the wedding. Then everything went well and the happy pair are now in Florida on their honeymoon.

THE ORTHWEINS, of St. Louis, Mo., are at the head of a new competitive telegraph enterprise. The family fortunes there were started by Charles W. Orthwein and his brother William D. Orthwein, who went to St. Louis from Germany many years ago, and established themselves in the grain commission business. The firm gradually built up a big export trade, in which in the last quarter of a century a fortune estimated at from $2,000,000 to $3,000,000 was made. Charles W. Orthwein died several years ago, leaving three sons, Max, Ralph and Armin. Max and Ralph are interested in the grain commission business with their uncle. William D. Ralph is largely interested also in the Sempire Clock Company, the American Association Baseball Club and minor enterprises, taking but little active interest in the grain business. Max is also financially interested in the baseball club, but devotes most of his time to the grain business. William D. Orthwein has one son, William D., Jr., who has been abroad for two years.

EDUCATIONAL.

Y. M. C. A.—A course in electricity is now being given by Mr. Edward Montchyk in the West Side Young Men's Christian Association, 318 West Fifty-seventh Street, New York City. The course aims at elementary but very practical instruction.

UNIVERSITY OF MICHIGAN.—The new engineeing building which is now being erected at the University of Michigan at a cost of $140,000 consists of a

main part and three large wings. The main part, which is in the extreme southeast corner of the campus is 57x66 feet on the ground and four stories high. It spans the diagonal walk which passes beneath the building as an arcade fourteen feet wide. A wing 60x174 feet in size extends west from the main portion, and another 60x213 feet extends to the north. At the end of this latter wing there is an extension 22x100 feet. Another wing 60x60 feet projects in the direction of the tall power house chimney.

STEVENS INSTITUTE OF TECHNOLOGY.—The Alumni of this excellent college are largely represented in the engineering and other scientific societies of the United States. A recent compilation showed that the American Society of Mechanical Engineers has in its membership list about 178 Stevens alumni, the American Institute of Electrical Engineers 63, the American Gas Light Association 30, the American Society of Naval Architects 9. The American Institute of Mining Engineers, American Institute of Heating and Ventilating Engineers, the American Association for the Advancement of Science and the several local engineering societies throughout the country all contain many Stevens graduates among their membership.

Trade Notes.

THE BURT MFG. CO., Akron, Ohio, has just made a shipment of 11 exhaust heads to a concern in Philadelphia.

THE NEW YORK AND OHIO COMPANY, Warren, Ohio, is putting on the market a high class of insulating cloths and varnishes. This is a new departure for the well-known concern named.

THE EASTERN CARBON WORKS, Jersey City, N. J., are sending out some handsome blotters about their carbons, batteries, brushes and other specialties, which are well spoken of wherever used.

REMOVAL.—The Columbia Electric & Mfg. Co., Newark, N. J., will, about March 1, move to its new factory at the corner of High Street and Boyden Place. Its business has increased to such an extent that it has been compelled to move into more commodious quarters. All interested in electric lamps are invited to call and see the Columbia arc lamp.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., gives much attention to the manufacture of lead pencils for special uses. As a result there are a great many different kinds of pencils, each with its special name. The latest addition to the list is the "Car Inspector" pencil. It has a strong, smooth lead, which will be found very suitable for general desk work.

THE BENJAMIN ELECTRIC MFG. CO., of Chicago, is opening offices at 27 Thames St., New York. The company manufactures the well-known Benjamin wireless clusters, in addition to which are some other specialties; and it is comtemplated that a full stock will be kept on hand. Mr. R. B. Benjamin, manager of the company, was a visitor to New York last week.

THE NATIONAL ELECTRICAL SUPPLY COMPANY, 1417 New York Avenue, Washington, D. C., has issued a series of 7 bulletins, devoted respectively to the Sumter "Bull's-Eye" express switchboard; "Sumterphones;" intercommunicating telephones; telephone accessories; construction tools, and line material. All of these devices and apparatus are illustrated and briefly described.

WESTINGHOUSE ELECTRO-PNEUMATIC CONTROL SYSTEM.—The Westingnouse Air Brake Company, Pittsburg, Pa., has brought out an artistically designed pamphlet describing and illustrating its electro-pneumatic system for controlling railway and other motors. This system as used on the Brooklyn Elevated Railways was described and illustrated in ELECTRICAL WORLD AND ENGINEER, Jan. 10.

THE MECHANICAL BOILER CLEANER COMPANY has received a letter from Mr. John I. Beggs, president of the Milwaukee Electric Railway & Light Company, in which he states that he now has fifteen of the Garrigus cleaners in operation, is equipping eight more and is gradually putting them on all his boilers. He writes that his experience has been such that he "unreservedly commends the cleaner," and that its use has enabled him to more than double the time between cleanings.

MESSRS EUGENE MUNSELL & CO., 218 Water St., New York, who have long been engaged in mining and importing mica, have recently added to their business the manufacture of mica specialties, such as lamp chimneys, canopies, candle shade protectors, etc. In their 1903 catalogue and price list, just issued, is a line of reflectors for incandescent electric lamps, which is absolutely new. Being made of the best clear mica, they cast absolutely no shadow, and it is claimed that they intensify the light four fold. Some of the forms are made to produce a flower-like effect, and when used with colored lamps for decorative purposes, the results are marvelous. Application has been made for a patent on these reflectors, and all of Messrs. Munsell & Co.'s mica specialties will be distinguished by the copyrighted word "Micanite." The catalogue and price list can be obtained on application.

PRINTERS' INK, which has rightfully earned the sobriquet, "The Little Schoolmaster of Advertising," has issued a book entitled "Leading Newspapers." This publication is not only devoted to dailies, but takes up class journals in addition. In commenting on the science of electricity mention is made of the fact that eighteen periodicals are published in this line, and a list is given of three weekly publications which are known to have a circulation of five thousand copies or over per issue. Of these three papers one is ELECTRICAL WORLD AND ENGINEER, and the other two are admittedly not electrical, except by association. Under the heading of "Engineering" a statement is made that 31 publications appear under this classification, and then follows a list of papers having admittedly a circulation of six thousand copies per issue or more. Under the heading of "Engineering" appear publications devoted to different branches, and the only electrical paper which is mentioned at all is ELECTRICAL WORLD AND ENGINEER. The testimony of the leading authority on newspaper advertising is convincing. The book contains 204 pages and is bound in cloth, with gold edges.

THE ALLIS-CHALMERS COMPANY will, on May 1, remove its general offices from the present location in the Home Insurance Building to the New York Life Building, corner of Monroe and La Salle Streets, Chicago. This move is only another indication of the progressive spirit which prevails in the management of this strong industrial. The Allis-Chalmers Company has for the past two years been expending enormous sums of money in betterments at its various plants at Milwaukee, Chicago and Scranton, so as to give its customers the best possible service in point of economy and quick deliveries. The new offices of the Allis-Chalmers Company will provide ample space for the various sales departments and general business offices which will be inducive of the best possible service to its trade. To give a fair idea of the scope of the business enjoyed by the Allis-Chalmers Company, it may be mentioned that during the past two months orders for either engines, mining machinery, rock crushing machinery, saw mill machinery and flour mill machinery were booked from every state in the Union, besides the following named foreign countries: England, South Africa, Mexico, Canada, Chile, Central America, Brazil, West Australia, Turkey, Finland, Yukon Territory, Belgium, British Columbia, Bolivia, Peru, China and Alaska, also the Hawaiian and Philippine Islands.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEBRUARY 17, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

720,550. ELECTRIC CIRCUIT AND POLARITY INDICATOR; V. G. Apple, Dayton, Ohio. App. filed June 17, 1901. A push button containing a small vessel of liquid which changes color when the current passes through it, to show that the circuit is operative when the button is pushed.

720,563. STORAGE BATTERY SYSTEM; R. N. Chamberlain, Depew, N. Y. App. filed Oct. 17, 1901. A polarization cell having a counter electromotive force equal to that of the end cell sections is included between the successive positions of a switch.

720,568. SPACE TELEGRAPHY; L. De Forest, Chicago, Ill. App. filed March 6, 1901. Provides means for the selective selection of waves, receivers being placed at nodal points of the circuit.

720,577. ELECTRIC BATTERY; E. R. Gill, New York, N. Y. App. filed June 26, 1900. A block containing cavities for dry cells, each of which has a spring contact which is engaged by terminals in a plate resting over the block.

720,592. ELECTRIC BATTERY; M. M. Kohn, Chicago, Ill. App. filed July 31, 1895. Details of a sealing and venting plug.

720,595. RINGING-GENERATOR; J. C. F. Malthaner, Minneapolis, Minn. App. filed September 13, 1902. (See page 364.)

720,596. ELECTROMAGNETIC RECIPROCATING TOOL; C. Marshall, Lafayette, Ind. App. filed June 8, 1901. A commutating switch adapted to alternately energize the solenoids and to momentarily short circuit each solenoid at the instant its circuit is broken, to discharge the self-induced current.

720,599. X-RAY TRACER; F. Moritz, Munich, Germany. App. filed Oct. 13, 1900. An adjustable frame embodying a drawing surface by means of which the exact shape, size and location of an object disclosed by the X-rays can be traced.

720,604. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Jan. 24, 1901. This invention and those which follow, by the same patentee, consists of various devices for automatically controlling the generation, storage and distribution of current in train lighting systems wherein the dynamo is driven from the axle of a car.

720,605. ELECTRIC TRAIN LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Sept. 9, 1901. See 720,604.

720,606. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Sept. 14, 1901. See 720,604.

720,607. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Oct. 26, 1901. See 720,604.

720,608. ELECTRIC TRAIN LIGHTING; J. F. McElroy, Albany, N. Y. App. filed Jan. 13, 1902. See 720,604.

720,609. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Jan. 16, 1902. See 720,604.

720,610. ELECTRIC LIGHTING SYSTEM; J. F. McElroy, Albany, N. Y. App. filed Feb. 19, 1902. See 720,604.

720,612. TROLLEY WHEEL; T. McWilliams, Kings Park, N. Y. App. filed April 12, 1902. A knock-down wheel in which the tread portion can be easily renewed.

720,621. APPARATUS FOR ELECTROMAGNETICALLY RECORDING SPEECH; W. A. Rosenbaum, New Rochelle, N. Y. App. filed June 22, 1901. (See page 364.)

720,633. TROLLEY; J. Spena, Lilly, Pa. App. filed Aug. 4, 1902. A device adapted to hold the wheel on the wire until the cord is pulled to release it.

720,636. AUTOMATIC HAMMER; E. H. Swift, Hartford, Conn. App. filed April 28, 1902. An electric hammer for gold beating, provided with automatic devices for regulating the stroke.

720,650. ELECTRIC ARC LAMP; A. Witte, New York, N. Y. App. filed

Feb. 26, 1902. An improvement in the gas check and an arrangement of two passages through one of which air can be forced to blow out the carbon dust in the globe, through the other.

720,653. ELECTRIC BATTERY; V. G. Apple, Dayton, Ohio. App. filed June 3, 1901. The conducting portion of one set of plates is cast integrally with the containing vessel.

720,661. REGULATING DEVICE FOR ELECTRICAL MACHINES DRIVEN BY STEAM MOTORS; Charles Eugen Lancelot Brown, Baden, Switzerland. App. filed Aug. 30, 1902. (See Current News and Notes.)

720,668. PRINTING TELEGRAPH; L. Cerebotani, Munich, Germany. App. filed July 3, 1899. Details.

720,674. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Feb. 12, 1902. A small regulating motor whose direction of rotation and consequent insertion or withdrawal of resistance in the field circuit of the dynamo is dependent upon the output of the dynamo, the latter being driven from the axle of a car.

720,675. SYSTEM OF DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed Feb. 12, 1902. Means for maintaining the voltage of a variable speed generator constant, and for regulating the lamp circuit in accordance with the rise in voltage while the load is being raised from zero to its maximum.

720,683. ENGINE STOP; W. H. Dunn, Wallingford, Conn. App. filed Feb. 3, 1902. The object is to maintain an alarm circuit so that a signal may be sent in from any point of the system to the attendant in charge of the mechanism to which the stop device is applied.

720,684. ELECTRIC RAILWAY; G. L. Fowler, New York, N. Y. App. filed July 18, 1900. A third rail having two contact faces, one on each side and protected by a sheet metal shield.

720,711. ELECTRICAL INFLUENCE MACHINE; S. Lemstrom, Helsingfors, Russia. App. filed Oct. 6, 1902. The drums are supported upon a pair of separate spindles which extend only to the ends of the drum and are thus as far apart as possible.

720,729. ELECTRICAL INTERRUPTER; G. P. McDonnell, St. Louis, Mo. App. filed March 17, 1902. A rotary disk having contacts on its face and a brush movable with respect thereto for interrupting the circuit to vary the strength without the aid of resistance.

720,741. ELECTROLYTIC DIAPHRAGM AND PROCESS OF MAKING SAME; Hugh Rodman, Philadelphia, Pa. App. filed March 18, 1902. (See Current News and Notes.)

720,772. ELECTRIC ARC LAMP; H. Baggett, London, England. App. filed Dec. 15, 1902. Details.

720,783. ANTISEPTIC ATTACHMENT FOR TELEPHONE-MOUTHPIECES; C. W. Clough, Watsonville, Cal. App. filed April 17, 1902. (See page 364.)

720,793. APPARATUS FOR REINFORCING AND STANDARDIZING FILAMENTS OF GLOW LAMPS; F. Fanta, London, England. App. filed July 11, 1901. Means for simultaneously treating the filament with hydrocarbon gas and taking photometric tests to determine when the filament has been sufficiently built up.

720,808. INCANDESCENT LAMP SOCKET; H. Hubbell, Bridgeport, Conn. App. filed May 26, 1902. Details.

720,858. SNAP SWITCH; W. C. Tregoning, Bridgeport, Conn. App. filed July 5, 1902. Details of a single button push switch.

720,875. TELEGRAPH SYSTEM; W. E. Athern, Brooklyn, N. Y. App. filed March 19, 1902. Apparatus whereby separate signals can be sent respectively by direct and alternating currents.

720,879. OVERHEAD TROLLEY; J. J. Bouchard, Bradford, Pa. App. filed Nov. 15, 1902. The wheel is mounted upon a kind of universal joint affording it freedom to alter its position when traversing curves.

720,880. TELEPHONE-RECEIVER HOLDER; A. J. Briggs, Allegheny, Pa. App. filed December 10, 1901. (See page 364.)

720,884. REGULATION OF ELECTRIC CIRCUITS; C. F. Burgess and B. Frankenfield, Madison, Wis. App. filed June 12, 1901. The circuit includes a coil of wire wound upon a core of magnetic material and constituting an inductive resistance for regulating the current and potential on a line.

720,885. SELF-INDICATING OPERATOR'S KEY; G. L. Burlingame, Chicago, Ill. App. filed April 3, 1902. (See page 364.)

720,888. X-RAY APPARATUS; E. W. Caldwell, New York, N. Y. App. filed Nov. 10, 1902. Details of the circuit interrupting apparatus.

720,898. MEANS FOR DISSIPATING ELECTRICITY IN SHEETS OF PAPER; Thomas C. Dexter, Pearl River, N. Y., and Thomas E. Breen, Colwyn, Pa. App. filed March 17, 1902. A heated blast is directed against the sheets of paper in feeding. The blast consists of heated air or the heated products of combustion of a mixture of air and gas.

720,901. TELEGRAPHIC SYSTEM; J. Doyle, Norwood, N. J. App. filed June 19, 1902. No circuit closers are employed on the keys, the normal position of the key being such as to keep the line closed.

720,917. ELECTRIC BRAKE; J. C. Henry, Denver, Colo. App. filed April 1, 1901. A reversing switch having contacts to connect the motor with the power circuit to drive it in either direction and also having contacts to connect the motor in a local circuit with a braking magnet.

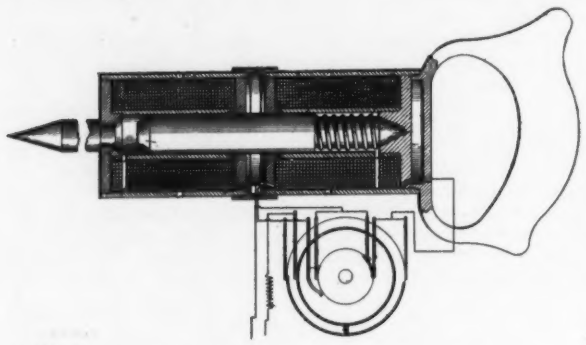
720,951. ELECTRIC BRAKE; F. C. Newell, Wilkinsburg, Pa. App. filed April 18, 1901. The invention consists in means whereby the same contact points on the controller may be used for braking as for running, while at the same time the controller handle is adapted to be moved in opposite directions from its "off" or neutral position for regulating the current in the running and braking circuits, respectively.

720,953. ELECTRIC LAMP SOCKET; M. Norden, New York, N. Y. App. filed May 12, 1902. Details of a lamp receptacle.

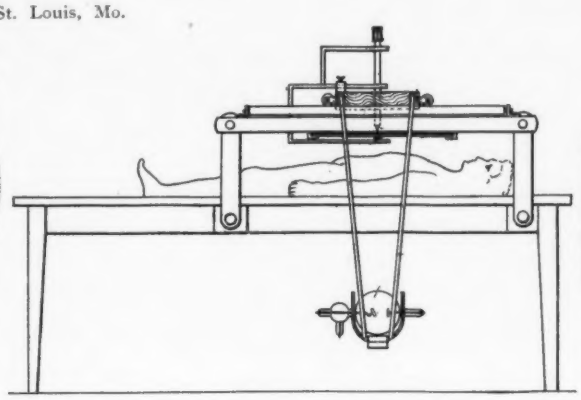
720,962. INCANDESCENT ELECTRIC LAMP; C. Pauthonier, Paris, France. App. filed July 7, 1900. An arrangement by which lamps can be connected in groups on high potential circuits as well as on the ordinary commercial circuits and afford increased illuminating power and reduce the consumption of current.

720,978. ELECTRIC VEHICLE BRAKE; C. J. Specht and C. R. Krueger, New York, N. Y. App. filed June 7, 1902. A hollow brake shoe containing electro-magnets for transforming the shoe into a magnet.

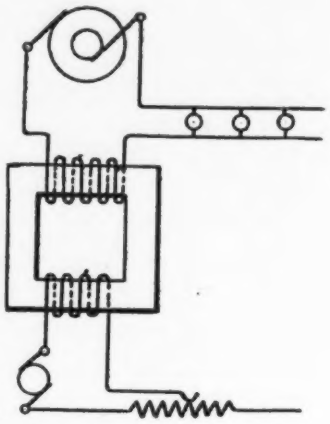
720,979. METER; William Stanley, Great Barrington, Mass. App. filed April 5, 1902. (See Current News and Notes.)



720,596.—Electromagnetic Reciprocating Tool.



720,599.—X-Ray Tracer.



720,884.— Regulation of Electric Circuits

720,980. METER; William Stanley, Great Barrington, Mass. App. filed June 25, 1902. (See Current News and Notes.)

720,981. APPARATUS FOR MEASURING THE ENERGY OF ELECTRIC CURRENTS; W. Stanley, Great Barrington, Mass. App. filed July 16, 1902. (See Current News and Notes.)

721,000. STREET RAILWAY SWITCH; W. J. Bell, Los Angeles, Cal. App. filed July 25, 1902. The switch tongue and switch throwing rail are normally coupled together to move in unison, the uncoupling being effected by electrical means controlled from the car, when the latter is to be switched from the main track.

721,025. DYNAMO DRIVING MECHANISM; J. L. Creveling, New York, N. Y. App. filed Nov. 29, 1902. Clutch mechanism and co-operating pulleys supported independent of and on opposite sides of the armature and adapted to communicate motion in one direction only to the armature irrespective of the reversals of the direction of movement of the source of power.

721,032. ELECTROMEDICAL BELT; F. Farmer, Richmond, Ind. App. filed Nov. 29, 1902. Details.

721,042. SOCKET EXTENSION TAP; H. F. Holland, Boston, Mass. App. filed Feb. 11, 1901. Taps located in the side of a lamp socket from which a branch circuit may lead.

721,068. APPARATUS FOR DECOMPOSING WATER BY ELECTROLYSIS; William F. Mason McCarty, Rockyridge, Md. App. filed April 22, 1902. Two upright tanks are connected about midway of their height by a horizontal conduit and have outlets at the upper ends. Each tank has an electrode having its upper end located between the upper and lower edge of the conduit. A water jacket surrounds the tank.

721,084. AUDIBLE ELECTRICAL TELEGRAPHY; R. Oxlade, Redfern, Sidney, New South Wales, Australia. App. filed April 9, 1902. The signals utilized are those produced by the break of the current in the primary of an induction coil and are responded to by telephone receivers.

721,124. CENTRAL-ENERGY TELEPHONE SYSTEM; F. W. Dunbar, Chicago, Ill. App. filed March 22, 1901. (See page 364.)

721,128. MULTIPLE SERIES SYSTEM OF ELECTRICAL DISTRIBUTION; F. H. Loveridge, Coldwater, Mich. App. filed Nov. 9, 1896. Means for automatically balancing a multiple series system of distribution.